VOYAGING BEYOND THE PILLARS OF HERCULES:

A MODEL FOR THE FUTURE ROLE OF HUMAN SPACEFLIGHT EXPLORATION IN US GRAND STRATEGY

By

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A DISSERTATION PRESENTED TO THE FACULTY OF THE

SCHOOL OF

ADVANCED AIR AND SPACE STUDIES

FOR COMPLETION OF DOCTORATE REQUIREMENTS

SCHOOL OF ADVANCED AIR AND SPACE STUDIES

AIR UNIVERSITY

MAXWELL AIR FORCE BASE, ALABAMA

JUNE 2013

Report Documentation Page

Form Approved
OMB No. 0704-0188

1. REPORT DATE	2. REPORT TYPE	3. DATES COVERED
JUN 2013		**00-00-2013 to 00-00-2013**

4. TITLE AND SUBTITLE	5a. CONTRACT NUMBER
Voyaging Beyond The Pillars Of Hercules: A Model For The Future Role Of Human Spaceflight Exploration In U.S. Grand Strategy	5b. GRANT NUMBER
	5c. PROGRAM ELEMENT NUMBER
6. AUTHOR(S)	5d. PROJECT NUMBER
	5e. TASK NUMBER
	5f. WORK UNIT NUMBER
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) **School of Advanced Air And Space Studies,,Air University,,Maxwell Air Force Base,,AL**	8. PERFORMING ORGANIZATION REPORT NUMBER
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)	10. SPONSOR/MONITOR'S ACRONYM(S)
	11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for public release; distribution unlimited

13. SUPPLEMENTARY NOTES

14. ABSTRACT

Why do states explore? The modern version of this question is, ???Why send people to explore space Idealists answer, ???Because humans are inspired by other humans exploring the unknown.??? In their view, the imperative to explore space is self-evident and self-sustaining because of the unquenchable curiosity of the human spirit to expand knowledge and tame the unknown. On the opposite side of the spectrum, pragmatists view sending humans to space as a useful endeavor only if the act tangibly addresses a competitive threat to some element of state national security. Absent this clearly defined purpose, human spaceflight is derided as an expensive state luxury with little public importance beyond trite references to Velcro??, Tang?? breakfast drink, or thrilling science fiction media. Both of these views have merit, yet they are also incomplete. The previous 50 years of human spaceflight exists within the same family of strategic exploration campaigns as the Ming Dynasty journeys of Admiral Zheng He, Vasco De Gama???s Indian Ocean voyages for Portugal, or the trek of Norway???s Roald Amundsen and Great Britain???s Robert Scott across the Antarctic. Surveying these types of campaigns is necessary for building a unified Exploration Model; one that synthesizes the best perspectives of both pragmatist and idealists to produce a better analytic framework for strategists. Once constructed, this model becomes the lens to analyze key episodes in American, Russian, and Chinese human spaceflight exploration. The lessons from these case studies form the basis of a viable human spaceflight strategy to enhance overall American spacepower in the face of rising competition and dwindling resources.

15. SUBJECT TERMS

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a REPORT **unclassified**	b ABSTRACT **unclassified**	c THIS PAGE **unclassified**	**Same as Report (SAR)**	**268**	

APPROVAL

The undersigned certify that this thesis meets doctorate standards of research, argumentation, and expression.

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The conclusions and opinions expressed in this document are those of the author. They do not reflect the official position of the US Government, Department of Defense, the United States Air Force, or Air University.

ABOUT THE AUTHOR

LtCol Randel Gordon was commissioned from the United States Air Force Academy in the top of his class in May of 1998 with a Bachelor of Science degree in Aeronautical Engineering. His first assignment was at Laughlin AFB as a student in Specialized Undergraduate Pilot Training (SUPT) in August of 1998. He was the Distinguished Graduate of class 99-13 at Laughlin and received his pilot rating in August of 1999. Upon graduation of SUPT, LtCol Gordon was assigned to the Introduction to Fighter Fundamentals (IFF) course at Columbus AFB, MS where he graduated as the Distinguished Graduate and Air-to-Air Top Gun of his class. Following this assignment, he was assigned to Tyndall AFB to become an F-15C Eagle fighter pilot. He was subsequently assigned to the 19th Fighter Squadron and 3rd Operational Support Squadron at Elmendorf AFB AK where he received numerous awards for flight leadership and officership. LtCol Gordon was accepted to the Air Force Institute of Technology (AFIT) in 2004 to study advanced aerospace concepts and graduated with a Masters degree in Aeronautical Engineering in 2006. His graduate Thesis was awarded the AFIT Dynamics Thesis of the year. LtCol Gordon also attended the USAF Test Pilot School from 2005 to 2006. There, he graduated in the top of his class and was assigned as a developmental test pilot for the 40th Flight Test Squadron at Eglin AFB. While at Eglin AFB, LtCol Gordon was qualified to fly the F-15C, F-15E, A-10A/C, and BD-700 Global Express Business Jet. After graduating in the top of his SAASS class in 2011, LtCol Gordon served as a DARPA Service Chief Fellow at Arlington VA and as the Future Capabilities Chief at USPACOM/J8. LtCol Gordon is a Senior Pilot with over 2500 hours of flight time and over 450 hours of combat over Iraq and Afghanistan. He has been married for 13 years. He and his wife are proud and loving parents to a nine-year-old son.

ACKNOWLEDGEMENTS

Without question, the existence of this dissertation, let alone the whole of my Air Force career, would not be possible without the loving support and counsel of my wife. She is my college sweetheart, best friend, closest confidant, and guiding star. Professional life as a military officer, operational fighter pilot, test pilot, philosophy doctorate student, engineering graduate student, combat veteran, freelance writer, and photographer has been extremely challenging. However, no matter how rigorous it has been for me, it cannot compare to the challenge endured by my wife to make all of that happen. There are truly no words in any language that can express my gratitude to her. The closest I can manage is to tell her "thank you" and "I love you." I am nothing without her.

I would also be remiss without thanking my Dissertation advisor, Dr. Everett Dolman, and Dissertation readers Colonel Dr. Michael Smith and Dr. David M Klaus. Because of them, my mind has been opened to fresh and exciting new vistas as I have challenged my own beliefs on everything. I've learned that the real purpose of finding answers is not to solve a problem, but to lead your soul to ask deeper questions.

My professional mentors, Dr. George Ka'iliwai and Brigadier General Ken Wilsbach, also provided phenomenal support in completing this Dissertation. Thank you for helping me hold PhD completion as a priority, even amongst the rough and tumble workload of full time staff work at USPACOM. Your guidance and constant encouragement has been deeply important to me and I am so grateful for your leadership…Mahalo Nui Loa!

I must also express my deep gratitude to the men and women of NewSpace, Boeing In-Space & Surface Systems, Orbital Sciences, Air and

Space Smithsonian, NASA, the White House Office of Science and Technology Policy, Scaled Composites, Virgin Galactic Special Projects, XCOR, SpaceX, and Lockheed Martin Orion who so gracious volunteered their time and expertise to be interviewed by me for this research. Everyday, these groups perform amazing miracles in their quest to, "slip the surly bonds of Earth and touch the face of God."[1] I was simply overwhelmed by their professionalism and passionate love of space. As the United States reflects upon the space program, the nation can also celebrate the tremendous future and hope provided by these organizations in advancing the saga of human spaceflight. America's spacepower leadership is far from over.

Finally, I would like to dedicate this Dissertation to the astronauts and cosmonauts who have given their lives in humankind's quest to explore and utilize the reaches of space. May we always honor them.

In Memoriam – *Ad Astra* (To The Stars)	
Mission	**Crew**
Training (23 Mar 61)	Valentin Bondarenko
Training (31 Oct 64)	Theodore Freeman
Training (28 Feb 66)	Elliot See, Charles Bassett
Apollo 1 (27 Jan 67)	Gus Grissom, Edward White II, Roger Chaffee
Soyuz 1 (24 Apr 67)	Vladimir Komarov
Training (5 Oct 67)	Clifton C.C. Williams
Training (8 Dec 67)	Robert Lawrence
Training (27 Mar 68)	Yuri Gagarin
Soyuz 11 (30 Jun 71)	Georgi Dobrovolski, Vicktor Patsayev, Vladislav Volkov
STS-51L (28 Jan 86)	Dick Scobee, Michael Smith, Greg Jarvis, Christa McAuliffe,Ronald McNair, Ellison Onizuka, Judith Resnik
Training (11 Jul 93)	Sergei Vozovikov
STS-107 (1 Feb 03)	Rick Husband, William McCool, Michael Anderson, David Brown, Kalpana Chawla, Laurel Clark, Ilan Ramon

[1] John Gillespie Magee Jr., "High Flight," *High Flight Productions*, http://www.highflightproductions.com/high_flight_productions/JohnMagee.html (Accessed 6 June 2013).

ABSTRACT

Why do states explore? The modern version of this question is, "Why send people to explore space?" Idealists answer, "Because humans are inspired by other humans exploring the unknown." In their view, the imperative to explore space is self-evident and self-sustaining because of the unquenchable curiosity of the human spirit to expand knowledge and tame the unknown. On the opposite side of the spectrum, pragmatists view sending humans to space as a useful endeavor only if the act tangibly addresses a competitive threat to some element of state national security. Absent this clearly defined purpose, human spaceflight is derided as an expensive state luxury with little public importance beyond trite references to Velcro©, Tang© breakfast drink, or thrilling science fiction media. Both of these views have merit, yet they are also incomplete.

The previous 50 years of human spaceflight exists within the same family of strategic exploration campaigns as the Ming Dynasty journeys of Admiral Zheng He, Vasco De Gama's Indian Ocean voyages for Portugal, or the trek of Norway's Roald Amundsen and Great Britain's Robert Scott across the Antarctic. Surveying these types of campaigns is necessary for building a unified Exploration Model; one that synthesizes the best perspectives of both pragmatist and idealists to produce a better analytic framework for strategists. Once constructed, this model becomes the lens to analyze key episodes in American, Russian, and Chinese human spaceflight exploration. The lessons from these case studies form the basis of a viable human spaceflight strategy to enhance overall American spacepower in the face of rising competition and dwindling resources.

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Introduction

FROM THE PILLARS TO POYEKALI!

When they saw me in my space suit and the parachute dragging behind me, they backed away in fear. I told them, 'don't be afraid, I am a Soviet like you, who has descended from space and I must find a telephone to call Moscow.'

Major Yuri Gagarin, 1961

Straddling the exit of the Mediterranean Sea are two mountains that stand like silent sentinels over emerald-blue waters. To the north, the Rock of Gibraltar's steep cliffs tower above the beautiful Spanish countryside. To the south, Mount Hacho overlooks the ancient North African city of Ceuta. Together, these two geographic features form the Pillars of Hercules.[2]

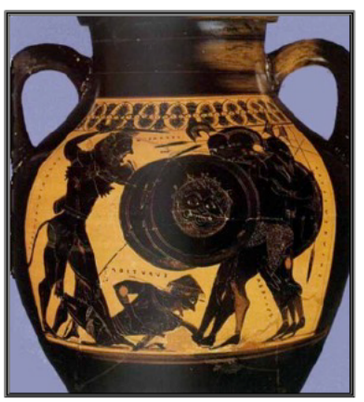

Figure 1: Hercules vs. Geryon

Source: Louvre Museum, http://traumwerk.stanford.edu/philolog/2010/04/dantes_monsters_in_the_inferno.html (Accessed 17 September 2012)

Named from Greek mythology, the Pillars mark the furthest distance Hercules traveled from home during his famous twelve labors of redemption. According to legend, King Eurystheus assigned Hercules his tenth labor of retrieving cattle from Geryon, a terrifying three-headed, three-legged beast that lived at the literal end of the world.[3] When he arrived at Geryon's fields, Hercules commemorated his perilous quest to Earth's edge by splitting a mountain in two; thereby separating the Iberian Peninsula from Africa, forming the Rock

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[2] Paul Theroux, *The Pillars of Hercules: A Grand Tour of the Mediterranean* (New York: Fawcett Books, 1995), 7.
[3] E.M. Berens, *Myths and Legends of Ancient of Ancient Greece and Rome* (Seattle, WA: CreateSpace Independent Publishers, 2011), 288-289.

of Gibraltar and Mount Hacho, and opening the famous Strait of Gibraltar waterway.[4] Never before has the end of the world been so clearly demarcated.

In ancient times, the Pillars of Hercules served as a true to life gateway from the known to the mysterious. Once sailors ventured past the Pillars, they made a transition from the familiar territory and placid waters of the Mediterranean to the stormy Atlantic filled with sea monsters eager to ravage their ships. Some sailed beyond the Pillars, innovated and explored, and returned home to greatness; many others sailed past the Pillars to their doom. Over the course of history, states have ventured beyond their own metaphorical Pillars of Hercules. In modern times, the most famous voyage to the mythical land of Geryon started barely 50 years ago.

The sprawling Baikonur Cosmodrome, located along the barren steppes of Kazakhstan, is forever enshrined as the place where humankind first left Earth to touch the stars. As dawn broke on the morning of 12 April 1961, the Baikonur Cosmodrome was awash in frenetic activity.[5] Clad in a bright orange pressure suit and white helmet emblazoned with


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The Huntsville Times

Man Enters Space

'So Close, Yet So Far,' Sighs Cape

U.S. Had Hoped For Own Launch

Soviet Officer Orbits Globe In 5-Ton Ship

Maximum Height Reached Reported As 188 Miles

Hobbs Admits 1944 Slaying

VON BRAUN'S REACTION:

To Keep Up, U.S.A. Must Run Like Hell'

Figure 2: The Flight of *Vostok 1* caused a Tectonic Geo-Strategic Shift

Source: "Yuri Gagarin in Space," *NASA*, http://www.ibtimes.com/articles/133020/20110411/yuri-gagarin-space-nasa.htm (Accessed 14 April 2011).

[4] Berens, *Myths and Legends,* 288-289.
[5] Nicholas L. Johnson, *Handbook of Soviet Space Flight: Vol. 48* (San Diego, CA: Univelt, 1980), 33.

the letters CCCP above the visor, 27-year-old Red Army Senior Lieutenant Yuri Gagarin waddled across the launch pad complex.[6] Surrounding Gagarin was a small horde of Politburo members and space program officials. Lieutenant Gagarin left the crowd behind as he slowly scaled the launch gantry steps towards his awaiting spacecraft. In the crowd below, Sergei Korolev, the shadowy Chief Designer of the Soviet rocketry program, fidgeted in nervous anticipation of the events about to unfold.[7] Korolev knew that a man's life and the entirety of the Soviet Union's glory was about to ride on his engineering judgment and expertise.

Atop the launch pad that morning was an R-7 intercontinental ballistic missile; modified to carry a human to Earth orbit instead of a nuclear weapon to Washington DC.[8] Gagarin squeezed inside the cramped confines of his *Vostok* (East) capsule, completed all pre-flight checks with launch control, and patiently awaited his destiny. As the countdown reached zero at 9:06 am local time, the R-7 roared off the Baikonur launch complex atop a column of crackling flames.[9] An excited Gagarin exclaimed "*Poyekali* (Let's go)!"[10] Several minutes later, *Vostok* 1 slipped gracefully into orbit thereby giving Gagarin the immortal distinction of Earth's first human star voyager. By the time he parachuted into a farmer's field near the Volga River approximately two hours after launch, Soviet leadership in Moscow had ceremoniously promoted Gagarin to the rank of Red Army Major.[11] Korolev was overjoyed; one more ship successfully returned from the realms beyond the Pillars of Hercules.

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[6] William E. Burrows, *This New Ocean* (New York: Random House, 1999), 311.
[7] James Schefter, *The Race* (New York: Doublesday, 1999), 9.
[8] David M. Harland, *The Story of Space Station MIR* (Chichester, UK: Praxis, 2005), 2.
[9] Ken Kremer, *Universe Today*,11 April 2011, http://www.universetoday.com/84738/yuri-gagarin-and-vostok-1-photo-album-50th-anniversary-of-human-spaceflight/,(Accessed 11 May 2011).
[10] Burrows, *This New Ocean*, 311.
[11] Schefter, *The Race*, 135.

The Dichotomy of Human Spaceflight Exploration

The flight of *Vostok 1* opened the reaches of space as a new and exciting front in the field of human exploration. The flight also ignited an intense inferno of national security fears that spread like wildfire across the world. As such, 12 April 1961 became a space-age milestone along a well-worn path winding through the dichotomy of exploration in state grand strategy. From the dreamers and idealists on one side, embracing the possibilities of a glorious yet-unknowable future ahead, to the grounded-in-reality pragmatists who seek first not to lose any advantage they already hold, state-sponsored exploration has been a tempestuous grand strategic struggle.

Why do states explore? The modern version of this question is, "Why send people to explore space?" Idealists answer, "Because humans are inspired by other humans exploring the unknown." In their view, the imperative to explore space is self-evident and self-sustaining because of the unquenchable curiosity of the human spirit to expand knowledge and tame the unknown. While this explanation is stirring and holds many elements of truth, it does not account for the overwhelming influence of geo-strategic context on state decisions. As a result, this model rings cavernously hollow when a state must make tough strategic choices amidst dwindling resources and escalating global challenges.

On the opposite side of the spectrum, harsh pragmatists view sending humans to space as a useful endeavor only if the act tangibly addresses a competitive threat to some element of state national security. Absent this clearly defined purpose, human spaceflight is derided as an expensive state luxury with little public importance beyond trite references to Velcro©, Tang© breakfast drink, or thrilling science fiction media. Unfortunately, this model is as incomplete as the

idealist view as this standpoint discounts the real and significant "intangible" benefits that motivate states to engage in exploration, such as enhancements to education, cultural richness, and societal inspiration.

In truth, strategists need a better model, one that synthesizes the best points of both idealists and pragmatists, to understand human spaceflight exploration's role in state grand strategy. For example, this model should have sufficient explanatory power to illuminate the complicated relationships between the Soviet's pragmatic motivations for *Vostok 1* as well as the strategic imperatives of this flight beyond satisfying imminent state national security needs. This model should also be useful for the strategist in understanding the reasons underlying both the rise and fall of state sponsored exploration campaigns.

Research Overview

The quest for global power and leadership is increasingly sailed upon the new ocean of space. As evidenced by the world's mounting technological reliance upon this medium for vital peace and wartime functions, space power is as significant to a state's international leadership today as land and sea power expertise were in molding the foremost states of modern history. Extensive studies exist to demonstrate the strategic significance of uninhabited spaceflight technologies, such as the Global Positioning System, communications satellites, and surveillance assets. However, a dearth of equivalent research exists for human spaceflight. As a result, human spaceflight's role in state strategy is often distorted and caricatured. In reality, the saga of modern exploration is testament to human spaceflight's use as both a tool of hi-tech statecraft as well as a wellspring to nourish societal inspiration.

Much as space is the frontier for modern states, the seemingly endless expanse of ocean and the foreboding challenge of crossing unexplored continental interiors were the frontiers of yesteryear. However, unlike states of today, states of yesteryear did not possess the means to explore these frontiers with satellites or rovers. While these uninhabited systems play an important role today, the continued direct presence of humans in modern spaceflight exploration carries with it the same special elements of risk and significance as that undertaken by states in historical campaigns across the sea and land. Hence, the past provides relevant data to highlight the important strategic arcs linking eras as disparate as the fifteenth century Age of Discovery and the Space Age of the twenty-first century.

The foundations for this space research, therefore, lay in studying key vignettes from the historical exploration campaigns of Europe, Asia, and the United States. Specifically, the previous 50 years of human spaceflight exist within the same family of strategic exploration campaigns as the Ming Dynasty journeys of Admiral Zheng He, Vasco De Gama's Indian Ocean voyages for Portugal, or the trek of Norway's Roald Amundsen and Great Britain's Robert Scott across the Antarctic interior. The sagas of these campaigns, spread broadly across nations and scenarios as diverse as twentieth century Great Britain to fifteenth century China, reveal the independent necessary and sufficient conditions required for exploration to exist. This historical survey also illuminates the constant dichotomy at play between pragmatic national security concepts, first enumerated by a realist interpretation of Thucydides' writings from the Peloponnesian wars, and idealist principles, first expounded by the teachings of Enlightenment era philosophers John Locke and Immanuel Kant.

With respect to pragmatic Thucydidean national security dynamics, the previous 50 years of human spaceflight exploration

demonstrate states' need to address fear, secure economic or political interests, and garner honor. In similar fashion, the previous 50 years of spaceflight also highlight how states have used human exploration as a tool to seek the Locke/Kant idealistic prize of transcendence on behalf of all humankind. Space continues to exist as the last great unknown; simultaneously a backdrop to project terrestrial-based national security issues as well as the only frontier from which the whole of the Earth and all of humankind appear united as one. Because of this, states have turned to human spaceflight exploration, much as states have turned to previous exploration campaigns, as the ultimate crucible to forge notions of human wonder as well as aggrandize raw state power in international relations.

Given the necessary conditions, defined as a frontier and the means with which to access that frontier, national security pragmatism becomes the initiating spark or sufficient condition of exploration while idealist principles create the flame to build an enduring legacy and support long-term legitimacy. The significance of this insight is that these necessary and sufficient conditions, combined with an understanding of the geo-strategic dichotomy between pragmatism and idealism, produce simple, repeatable, and recognizable patterns that can help a strategist understand the nature of how state explorations initiate, sustain, and conclude. This nature of state exploration is the all-important dependent variable of this research and can take the form of three broadly defined archetypes; exploration campaigns that are led more by pragmatic concerns, those that feature more idealistic principles, and ones that are a rough parity mix of the two. This insight is the critical premise of this research and helps to clarify an often-misunderstood phenomenon with respect to exploration.

Contrary to popular belief, state human spaceflight exploration's sole purpose is not simply, "to boldly go where no man has gone

before."[12] Nor is its role purely designed to address the pragmatic desire, "to crush your enemies and see them driven before you."[13] Instead, all state explorations derive from a synergy of both pragmatic and idealistic perspectives resulting in several different overarching exploration campaign characteristics that defy dogmatic appeals to one viewpoint vice the other. This dynamic, captured in the Exploration Model developed for this study, is thus useful for understanding key episodes in the saga of modern day American, Russian, and Chinese human spaceflight.

This study is of potential contemporary importance for the United States as recent tectonic shifts in the political and economic environment have caused America's current human spaceflight program to reach an unprecedented crossroad. To a much greater extent than at any other time in spaceflight history, the future viability of America's space efforts hinge on the crucial strategic decisions made by today's national leadership. In this regard, the purpose of the Exploration Model is to help craft the future of human spaceflight in America's overall grand strategy. To avoid the grievous fate of previous space exploration initiatives, such as the 2004 Vision for Space Exploration or the 1989 Space Exploration Initiative, this new strategy must appeal to the needs and capabilities of the American populace, space program leadership, and political elite. Only through a concerted and serious strategy designed to leverage the unique advantages of America's culture, resources, and space industry can the United States effectively grow space leadership for the future.

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[12] Gene Roddenberry (Producer), & Robert Wise (Director). (1979). *Star Trek: The Motion Picture* [Motion Picture]. United States: Paramount Pictures.
[13] Buzz Feitshans (Producer), & John Milius(Director). (1982). *Conan the Barbarian* [Motion Picture]. United States: Universal Films.

Chapter Overview

Chapter 1 begins this research through a survey of some of the most famous human exploration campaigns of history. Specifically, the naval voyages of Admiral Zheng He during China's Ming Dynasty, Vasco de Gama's journeys to India, and the race between Norway's Roald Amundsen and Great Britain's Robert Scott across Antarctica provide selected vignettes into the major patterns formed in the dynamic between pragmatism and idealism in exploration. Although these voyages rightfully live in the modern conscience as idealist examples of human achievement in exploring the unknown, chapter 1's survey reveals the often hidden pragmatist influences that interweaved into the fabric of these journeys.

Chapter 2 adds several supporting sub-vignettes to the examples surveyed in chapter 1 to construct the Exploration Model; the central analytical tool of this research. This model seeks to emulate the synergy of pragmatist and idealist concepts in state exploration. It also defines the necessary conditions of exploration; namely a frontier and the means with which to access that frontier. The dynamic formed in this model highlight two major themes; 1.) Pragmatist based national security is the catalyst spark or sufficiency condition of state exploration, but idealist thought is vitally important as a flame to secure long-term state legitimacy and legacy—Each requires the other and both have important roles to play; and 2.) Pragmatist and idealist notions combine to produce simple, predictable, and repeatable patterns of state exploration behavior useful for developing future strategy. This pattern defines the nature of exploration; the dependent variable of this research.

Within the Exploration Model, three major analytical patterns exist. Type 1 explorations birth primarily from a pragmatic need to

explore or exploit a frontier because of an urgent national security need. As a result of this strong tie between exploration and state utility, explorations of this type are the easiest for states to justify and the most common. Within Type 1, notions or achievements of idealist transcendence can be present, but tend to be incidental in nature. A par balance of idealism and pragmatism fuels type 2 explorations. They represent a sweet spot in state exploration that is difficult to sustain long term due to the fragility of the geo-strategic context that creates them. Type 3 explorations motivate primarily from idealist principles. Because Type 3 explorations do not address an imminent national security need, campaigns of this type tend to be the most difficult for states to initiate. However, due to their idealist-based motivations, achievement of Type 3 exploration end goals tends to produce a positive long-term legacy for the state. These Exploration Model patterns of state behavior are important for understanding the saga of modern day human spaceflight exploration.

Chapter 3 traces the lineage and impact of pragmatist national security and idealist transcendence in the space programs of the free and communist worlds. According to the Exploration Model developed for this research, these factors combined to produce a Type 2 class of exploration; one fueled by strong influence from both pragmatism and idealism. The chapter begins with a study of how Russian and American societal concepts and governance relate to their own visions of idealist thought writ large with respect to aerospace technology during the birth of flight. Understanding these beliefs is important as they play a crucial role in shaping the foundation of spaceflight technology development for pragmatic national security purposes.

By the early 1960s, the Soviet Union and the United States were firmly embroiled in a Cold War struggle for global hegemony. In his famous 1962 speech, President John F. Kennedy pledged the moon as a

space program objective for the same reason men climbed high mountains, flew across the Atlantic, or, he jokingly added, why Rice played Texas.[14] For him, a space race to the moon was an intentionally difficult objective that would become the most visible symbol of a high stakes ideological competition.[15] Victory in the space race was a matter of demonstrating to the world the superiority of either the Soviet's brand of communism or the West's style of democracy. It was a chance for the Kennedy administration to counter embarrassing political losses to the Soviets over Gagarin's flight and the Bay of Pigs fiasco.[16] The ethos undergirding the Soviet *Vostok*, *Voshkod*, and *Soyuz* programs was the direct analog to the spirit of the US Mercury, Gemini, and Apollo projects. The military cosmonauts and astronauts recruited within these respective programs became space age soldiers on the frontline of a global clash of civilizations. However, with the 1969 triumphal success of the Apollo 11 mission, the dynamics at the core of the Exploration Model shifted dramatically. The Americans attained the equivalent of a Pyrrhic victory strategic overreach. The luster of the Type 2 Exploration Model path for human spaceflight began to tarnish, thereby altering Soviet and American space exploration efforts for decades to come.

Concurrent with the start of the space race was a growing, but covert, demand for human spaceflight as a tool for military applications. This resulted in a split path; one well-known path, described in chapter 3, that emphasized Type 2 exploration pragmatism and idealism via headline grabbing human spaceflight achievements, and one lesser-known path, described in chapter 4, which focused on addressing

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[14] President Kennedy's Address on National Space Effort, 12 September 1962, http://www.jfklibrary.org/Research/Ready-Reference/JFK-Speeches/Address-at-Rice-University-on-the-Nations-Space-Effort-September-12-1962.aspx (Accessed 15 January 2011).
[15] Burrows, *This New Ocean*, 323.
[16] Schefter, *The Race, 137.*

urgent national security concerns under Type 1 exploration using piloted combat space-planes and crewed orbiting battle stations. This turbulent period of the space program highlights how the Exploration Model's interplay between pragmatism and idealism can cause major shifts in state exploration behavior.

Within America, fears of strategic surprise from the Soviet Union drove the United States Air Force to advocate for a military role in human spaceflight. Grandiose visions of spacepower fighters and bombers as the natural extension of their airpower equivalents heavily influenced Air Force strategic thinking.[17] A plan for Dyna-Soar, a sleek, exo-atmospheric, multirole, piloted vehicle was the natural outgrowth of this geo-strategic context.[18] In addition, the Air Force produced designs for a Department of Defense version of the Gemini capsule known as Gemini-B.[19] The purpose for this highly modified Air Force spacecraft was to service the Manned Orbiting Laboratory; a proposed military surveillance and command and control space station.[20] Neither program achieved operational status, however, both served to instill fear in the Soviets to build similar capabilities.

Raketoplan (Rocket Glider) was the Soviet's main response to the Dyna-Soar program.[21] Much like its American counterpart, *Raketoplan* was technologically audacious, geo-strategically electrifying, but ultimately economically and politically unsustainable. Like Dyna-Soar, *Raketoplan* never achieved operational spaceflight. However, the Soviets successfully built and orbited three of their celebrated *Salyut* (Salute)

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[17] Bernard Schriever, "Manned Operational Capability in Space," Air Force/Space Digest 44, November 1961.
[18] Steven R. Storm, *Aerospace*, "Jurassic Technology: The History of the Dyna-Soar," http://www.aero.org/publications/crosslink/winter2004/01.html (Accessed 13 April 2011).
[19] Burrows, *This New Ocean*, 255.
[20] Burrows, *This New Ocean*, 255.
[21] Asif A. Siddiqi, *Challenge to Apollo: The Soviet Union and the Space Race 1945-1974,* NASA SP-2000-4408, 231.

stations as secret military platforms.[22] Designated by the Soviets under the *Almaz* (Diamond) code word, these space stations were a direct counter to the proposed US Air Force Manned Orbiting Laboratory.[23] Military cosmonauts solely operated the *Almaz* stations and intended the use of the station's advanced surveillance equipment for spy missions against the United States.[24] One of the three *Almaz* platforms also featured a 23mm cannon, giving the station the ability to destroy enemy satellites or defend against boardings from enemy spacecraft.[25] These stations represented the pervasive distrust the Soviet government held against the United States. However, most space efforts in the 1970s were not warlike in nature. Both the United States and Soviet Union embarked on serious efforts to use human spaceflight as a tool for peace through the fostering of cooperative ideals.

The 1970s dawned with both the United States and the Soviet Union seeking opportunities to thaw Cold War relations. The nuclear stockpiles of both nations had escalated to absurd levels, the Vietnam War was straining US domestic society and power abroad, and the Soviets were fearful of a US-Sino alliance after President Richard Nixon's famous 1972 trip to China.[26] As a result, both the United States and Soviet Union pursued an overarching policy of *Détente* (Relaxation) with arms limitation treaties designed to ease tensions from the brink of nuclear Armageddon.[27] The human spaceflight contribution to *Détente* was the 1975 Apollo-*Soyuz* Test Project.[28] Soviet Premier Aleksei Kosygin and President Richard Nixon used this space initiative as a

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[22] Nicholas L. Johnson, *Handbook of Soviet Manned Space Flight*, (San Diego, CA: Univelt, 1980) 213-217.
[23] Johnson, *Handbook of Soviet Space Flight*, 213-217.
[24] Baker, *Manned Space Stations*, 15.
[25] Baker, *Manned Space Stations*, 51.
[26] Walter A. McDougall, *...The Heavens and the Earth* (Baltimore: MD, John Hopkins, 1985), 422.
[27] Lawrence Freedman, *The Evolution of Nuclear Strategy* (New York: Palgrave, 2003), 338.
[28] Baker, *Manned Space Stations*, 55.

symbolic gesture of good will between their two nations.[29] The famous on orbit handshake between then Air Force Colonel Tom Stafford and then Russian Air Force Colonel Alexei Leonov was a beacon of hope for a world weary of nuclear fears.[30]

Nonetheless, the early 1980s witnessed a return to frigid relations between the United States and the Soviet Union. The 1979 Soviet invasion of Afghanistan, US boycott of the 1980 Olympics in Moscow, revitalized US defense spending, and instability in Russia following the death of Brezhnev all contributed to stolid Cold War attitudes.[31] Amidst dwindling political and economic support, the National Aeronautics and Space Administration (NASA) turned from conducting lunar missions to operating a reusable vehicle to operate in low Earth orbit.[32] The Space Transportation System, commonly known as the Space Shuttle, was a hybrid of civil and Department of Defense (DOD) requirements. For example, the need to accommodate DOD classified payloads drove the dimensions of the Space Shuttle's cargo bay, while technical and budgetary obstacles drove NASA to opt for a partially, vice fully, reusable spacecraft design.[33] Proposing to launch payloads from both the civil and defense sector, as well as estimates of up to 50 missions per year, helped to reduce anticipated program costs.[34] Reality, however, differed wildly from initial program estimates. As a result, the

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[29] Burrows, *This New Ocean*, 447.
[30] Rex Hall, Soyuz: A Universal Spacecraft (Chichester, UK : Springer Praxis, 2003), 212.
[31] "Iranian Revolution," *Nova Online*, http://novaonline.nvcc.edu/eli/evans/his135/Events/Iran79.htm (Accessed 18 February 2011); James Phillips, "The Soviet Invasion of Afghanistan", *The Heritage Foundation*, http://www.heritage.org/research/reports/1980/01/the-soviet-invasion-of-afghanistan (Accessed 10 March 2011); and Pierre Tristan, "The 1980 Olympics Boycott over the Soviet Invasion of Afghanistan", *Middle East Issues*, http://middleeast.about.com/od/afghanistan/a/me080803.htm (Accessed 11 March 2011).
[32] David M. Harland, *The Story of the Space Shuttle* (Chichester, UK: Praxis, 2004), 3.
[33] National Aeronautics and Space Administration, *Columbia Accident Investigation Report*, (Washington, DC: NASA, August 2003), 22.
[34] Harland, *Story of the Space Shuttle*, 2-3.

Space Shuttle only performed a few dedicated military missions. The vast majority Space Shuttle missions were for idealist oriented civil and scientific purposes. Cold War tensions, however, made the Soviets view the Space Shuttle as an ominous military spaceplane capable of delivering a nuclear payload against the Soviet Union or disabling Soviet satellites.[35] As such, the Soviets initiated a crash program to build the *Buran* (Snowstorm) spaceplane to counter the perceived military capabilities of the American Space Shuttle.[36] Although canceled after only one remotely piloted orbital flight, *Buran* was still a stunning achievement of the Soviet space industry. However, *Buran's* breakneck development amidst tremendous Soviet financial and political upheaval highlighted the insatiable grand strategic need of the Soviet Union to match Western capabilities, even if those capabilities were largely non-existent. Just as the Americans experienced during the Apollo program, the Soviets fell victim to their own version of strategic overreach.

Chapter 5 uses the Exploration Model to understand the 1980s and post-Cold War use of human spaceflight for Type 1 explorations sparked by pragmatic national interest issues. For the United States, President Ronald Reagan envisioned the use of Space Station Freedom as a tool to unite Western nations and advance scientific knowledge.[37] The Soviets envisioned the *Salyut* guest cosmonaut program and space station *Mir* (Peace) as a means to help solidify their political influence over the fellowship of communist nations.[38] In the 1990s, President Bill Clinton and Russian President Boris Yeltsin shaped the trajectories of

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[35] Bart Hendrickx and Bert Vis, *Energiya-Buran: The Soviet Space Shuttle* (Chichester, UK, Praxis, 2007), 54-55.
[36] Hendrickx and Vis, *Energiya-Buran, 82-85.*
[37] "President Ronald Reagan 25 January 1984 State of the Union Address," *Federalism and the new Conservatism,* http://reagan2020.us/speeches/state_of_the_union_1984.asp (Accessed 20 March 2011).
[38] Roger D. Launius, *Space Stations: Base Camps to the Stars* (Washington, DC: Smithsonian, 2003), 101.

their respective space programs to match broader post-Cold War goals. The United States used the Shuttle-*Mir* partnership to bolster overall foreign policy diplomatic initiatives, while the Russians used it as a tool to extract steep financial gains in order to keep their post-revolutionary government legitimate.[39] Similar efforts to advance national interest continue today with the multi-national consortium involved with the construction and operation of the International Space Station (ISS).

Furthermore, both the ISS and *Mir* have served as destinations for a budding human commercial space tourism industry. For example, in 1990 the Tokyo Broadcasting System paid the Russian government $28 million to fly a Japanese journalist aboard *Mir* for a week.[40] Wealthy businesspeople such as Dennis Tito, Mark Shuttleworth, and Anousheh Ansari paid millions of dollars to the Russian Space Agency for brief flights to the ISS.[41] Space flights of this nature satisfy Type 1 state exploration behavior as they help to both generate state income as well as inspire humankind by spring boarding the development of an indigenous commercial space industry with the potential for broad public participation.

Chapter 6 applies the Exploration Model to the growth of Chinese human spaceflight for use in Type 2 exploration. In 1956, China began its space program primarily as a means to address regional security fears.[42] The UN-sanctioned war in neighboring Korea, US support for Taiwan during the Quemoy and Matsu islands incident, and strained relations with the Soviet Union convinced the Chinese leadership of the need to develop a deterrence capability based on nuclear missile

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[39] Burrows, *This New Ocean*, 605-609.
[40] Harland, *Space Station Mir, 202.*
[41] Anousheh Ansari, *My Dream of Stars: From Daughter of Iran to Space Pioneer* (New York: Palgrave MacMillan, 2010), 96.
[42]Roger Handberg and Zhen Li, *Chinese Space Policy: A Study in Domestic and International Politics* (New York: Routledge, 2007), 57.

technology.[43] Although Chinese efforts met with some initial success in rocket production and satellite design, mass poverty, lack of industrialization, and crippling natural disasters hamstrung the space program.[44] Efforts for a human space program to advance Chinese honor and communist ideals began as early as 1966 during China's Cultural Revolution.[45] However, Chairman Mao Tse-Tung's vicious societal purges further hampered the scientific and industrial base needed to support a modern space program.[46] Although China instituted a significant effort to train and equip for human spaceflight, political, economic, and social turmoil meant that none of the original 19 taikonauts selected from the People's Liberation Army Air Force (PLAAF) ever flew.[47]

During the 1980s, the governance policies of China's communist party leader Deng Xiaoping focused on rebuilding Chinese domestic society and economic power following Mao's Cultural Revolution.[48] As such, Xiaoping believed that China had no need to land people on the moon and instead focused on producing and launching uninhabited commercial satellites.[49] Ironically, Xiaoping's steady build-up approach allowed China to construct the technological infrastructure and operational expertise required for a robust human space program. By the late 1990s, China revived its human space program as a means to advance both national security interests and idealist aspirations by symbolically uniting its domestic population, solidifying prestige, and

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[43] Campbell Craig, *Destroying the Village* (New York: Columbia University Press, 1998), 52.
[44]Handberg and Li, *Chinese Space Policy*, 63.
[45] "Shuguang-1," *Astonautix*, http://www.astronautix.com/craft/shuuang1.htm (Accessed 23 March 2011).
[46] Roderick MacFarquhar and Michael Schoenhals, *Mao's Last Revolution* (Cambridge, MA: Harvard, 2006), 7-13.
[47] Seedhouse, *The New Space Race*, 13.
[48] Seedhouse, *The New Space Race, 15.*
[49]Handberg and Li, *Chinese Space Policy*, 84.

enhancing its scientific prowess.[50] Although seemingly a civil program through the Chinese National Space Agency (CNSA), the Chinese space program is in reality an arm of the Chinese military and its astronaut cadre consists exclusively of officers from the PLAAF.

China designed its modern human space program to leverage previously invented space technologies. This quick generational skip approach allows China to achieve parity with the United States and Soviet Union despite a four-decade late start. Hence, the mission objectives of the Chinese *Shenzhou* (Sacred Vessel) spacecraft have aggressively grown and the crew sizes have rapidly expanded from one to three taikonauts.[51] As testament to this generational skip approach, on only China's third human spaceflight mission, taikonaut Zhai Zhigang successfully conducted a spacewalk; an accomplishment that took both the United States and Russia eight human spaceflight missions respectively during the 1960s.[52] In 2012, China flew its first mission to a Chinese produced space station prototype, further adding credibility to the nation's space exploration efforts. China has further professed a desire to land taikonauts on the moon during the 2020 to 2025 timeframe.[53] Unlike the United States, China possesses the resources, political will, and geo-strategic context to accomplish this goal. These accomplishments and bold future mission statements have made the rise of the Chinese human spaceflight program impressive.

For the United States, this resurgence arrives at a time when the current American human space program is in transition. Per the Exploration Model, America has shifted from Type 1 exploitation of space to a Type 3 exploration campaign motivated by idealistic

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[50]Handberg and Li, *Chinese Space Policy*, 137.
[51] "Shenzhou 7," *Astronautix*, http://www.astronautix.com/flights/shezhou7.htm (Accessed 26 March 2011).
[52] Seedhouse, *The New Space Race, 193.*
[53] Seedhouse, *The New Space Race,* 146-147.

principles to expand human presence beyond cis-lunar space. However, austere contemporary political and economic constraints dictate a new approach is required for the US space program if it is to remain globally competitive and accomplish its intended Type 3 exploration goals. As part of the 2004 Vision for Space Exploration (VSE) plan under President George Bush, the US Space Shuttle fleet was retired from service during the summer of 2011.[54] In a significant deviation from the original plan, however, President Barack Obama canceled the follow on government space program, known as Constellation, in 2010 citing claims of extreme cost overruns and excessive schedule delays.[55] Compounding this reality is the fact that between the unveiling of VSE and its ultimate cancelation, President Bush did not propose, nor did Congress appropriate, additional funding to scale up NASA's budget to encompass the development of new vehicles and missions designed to voyage beyond cis-lunar space.[56] Nor did the expensive infrastructure or existing mission sets of NASA, birthed in the context of the 1960s Cold War against the Soviets, scale significantly back to match the limited resources of the post-Space Shuttle era. As a result, NASA is now stuck in the doldrums of a strategic trap; simultaneously lacking a vehicle to explore space yet unable to garner sufficient resources and support for the follow on spacecraft program, known as the Orion Multi-Purpose Crew Vehicle (MPCV) and the Space Launch System (SLS) booster.

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[54] "As Shuttle Nears Retirement, U.S. Weighs Options for Future Space Exploration," *Radio Free Europe*, http://www.rferl.org/content/As_Shuttle_Nears_Retirement_US_Weighs_Options_For_Future_Space_Exploration/1884779.html (Accessed 20 April 2011).

[55] Jonathan Amos, "Obama cancels Moon return project," *BBC Magazine*, 1 February 2010, http://news.bbc.co.uk/2/hi/science/nature/8489097.stm (Accessed 15 January 2011).

[56] National Research Council, *NASA's Strategic Direction and the Need for Consensus* (Washington, DC: National Academies Press, 2012), 11.

Because of this reality, the US government, steeped in technocratic bureaucracy, can no longer be the sole source of national human spaceflight innovations. Instead, America must now increasingly rely on the commercial sector to carry the mantle of the American human spaceflight program. Chapter 7 describes efforts by commercial companies such as SpaceX, XCOR, and Virgin Galactic to broker a new era of commercial human spaceflight. In partnership with NASA, companies within the Commercial Crew Development program will assume operations within low Earth orbit and resupply missions to the International Space Station.[57] Presumably, NASA will then be able to use its limited resources to execute Type 3 exploration in support of American grand strategic objectives as outlined within the 2010 National Space Policy and 2011 National Security Space Strategy.

Chapter 8 serves as a summary research chapter that outlines the lessons of this study and a cohesive strategy to enhance America's future space leadership. Given today's environment of dwindling state resources, the path outlined by this research offers the best chance to preserve American space leadership for the future. NASA administrator Charles Bolden explained this concept best when he stated, "Mars is the goal. Reliance upon the commercial sector is no longer an option. It is the [emphasis added] way forward for the US space program."[58]

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[57] "Commercial Crew and Cargo," *National Aeronautics and Space Administration*, http://www.nasa.gov/offices/c3po/home/index.html (Accessed 14 January 2011).
[58]USMC Maj.Gen(ret) and current NASA Administrator Charles Bolden, Honorary PhD acceptance speech to Air University, Maxwell AFB, October 2010.

Chapter 1

FOR KING AND COUNTRY

> *Rulers greedy of power saw in their mind's eye an increase of their possessions. Men thirsting for gold dreamed of an unsuspected wealth of the alluring metal. Enthusiastic missionaries rejoiced at the thought of a multitude of lost sheep. The scientifically trained world waited modestly in the background.*
>
> Roald Amundsen, 1912

Their romanticized exploits exist within the collective sub consciousness of modern life. However, their full stories remain elusive. For example, consumers purchase Magellan© Global Positioning Systems (GPS) to help find new destinations in unfamiliar places across the world.[1] Few of these same consumers care to know much detail surrounding the global circumnavigation voyage and ignoble end to the company's namesake, Spanish explorer Ferdinand Magellan. American schoolchildren learn the romanticized legend of Sacajawea; a beautifully mysterious "savage" woman who saved the American frontier expedition of Meriwether Lewis and William Clark.[2] However, the state motivations behind their voyage remain less popularized. The US named the American Space Shuttles *Endeavor* and *Discovery* after eighteenth century British sailing ships under the command of Captain James Cook.[3] Less well known are the secret objectives of conquest that accompanied Cook's otherwise grand scientific voyages across the Pacific. A state of the art, multi-national scientific research station

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[1] "Magellan GPS," *Magellan*, http://www.magellangps.com (Accessed 12 August 2012).
[2] Bonnie Butterfield, "Sacagawea: Captive, Indian Interpreter, Great American Legend: Her Life and Death," http://www.bonniebutterfield.com/NativeAmericans.html (Accessed 12 August 2012).
[3] "NASA Orbiter Fleet," *NASA*, http://www.nasa.gov/centers/kennedy/shuttleoperations/orbiters/orbiters_toc.html (Accessed 1 December 2012).

exists at the South Pole named after explorers Robert Scott and Roald Amundsen.[4] Few, except the intrepid researchers who deploy there, understand the geo-strategic context and impact of Scott and Amundsen's South Pole race upon the early twentieth century world.

Hidden within these expeditions are treasure troves worth of valuable information useful for constructing a model for exploration. Consequently, the first step in this study is to survey several important state sponsored human exploration campaigns of the past. These expeditions, specifically the voyages of China's Admiral Zheng He, Portugal's Vasco De Gama, and the South Pole race between explorers from Great Britain and Norway, are emblematic of the major motivations behind state exploration. The themes uncovered in these three major vignettes, accompanied by supporting evidence from additional sub-vignettes in chapter 2, form the basis for constructing the Exploration Model.

The Barbarians from across the sea…

In the Lamu archipelago near the border between modern day Kenya and Somalia lays the small island of Paté. The island's treacherously dangerous coastline, non-existent infrastructure, and dense forest have preserved its strict geographic and cultural seclusion from the outside world.[5] Paté's remote isolation, rugged even by the standards of sub-Saharan Africa, might have consigned it to the dustbin of history were it not for one deeply profound theory concerning the ancestry of the Famao; a small community that has lived on Paté for centuries.[6] Famao, unlike other tribes that reside in the region, possess

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[4] "Amundsen-Scott South Pole Station," http://www.southpolestation.com (Accessed 3 December 2012).
[5] Nicholas D. Kristof, "1492: The Prequel," *New York Times Magazine*, 6 June 1999, http://www.nytimes.com/1999/06/06/magazine/1492-the-prequel.html?pagewanted=all&src=pm (Accessed 10 December 2012).
[6] Kristof, "1492," (Accessed 10 December 2012).

Asian like facial features, such as narrow eyes and light skin complexion.[7] Archaeological and cultural studies in the area have discovered unusual concentrations of Chinese porcelain amongst the Famao, evidence of a silk industry on the island, and musical styles and language structures traditionally associated with Chinese, as opposed to African, heritage.[8] According to Famao oral traditions, these curiously unique characteristics trace from the survivors of a Chinese trading vessel that shipwrecked on the island many centuries earlier.[9] If true, the Famao stand as modern day living testaments to an era in which China stood astride the world as the Colossus of exploration. It also provides a perspective onto the Achilles Heel that can weaken all great exploration campaigns.

China, in the fourteenth century of the Common Era (CE), was experiencing a time of momentous upheaval. After years of brutal warfare, the Han Chinese finally overthrew the Mongol led Yuan dynasty in 1368 and established the vaunted Ming Dynasty.[10] Zhu Yuanzhang, the empire's first ruler, worked to rebuild relative peace and stability by structuring Chinese society along traditional agrarian ideals and a Confucian based code of laws antithetical to expansionism.[11] Emperor Yuanzhang named his grandson, Zhu Yuanwen, as his successor in hopes of continuing these societal reforms following his death.[12] Nonetheless, Yuanzhang's death in 1398 triggered a period of dynastic

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[7] Joseph Kahn, "China has an Ancient Mariner to Tell You About," *New York Times*, 20 July 2005, http://www.nytimes.com/2005/07/20/international/asia/20letter.html?pagewanted=all&_r=0 (Accessed 10 December 2012).
[8] Kristof, "1492," (Accessed 10 December 2012).
[9] Kahn, "China has an Ancient Mariner," (Accessed 10 December 2012).
[10] Sue Gronewald, *The Ming Voyages: A Teaching Unit*, (New York: Columbia University Press, 2005), 1.
[11] Louise Levathes, *When China Ruled the Seas: The Treasure Fleet of the Dragon Throne 1405-1433* (New York: Oxford University Press, 1996), 55.
[12] David M. Robinson, "Banditry and the Subversion of State Authority in China: The Capital Region during the Middle Ming Period (1450–1525)," *Journal of Social History* (Spring 2000): 527.

turmoil as reformist Zhu Di, the son of emperor Yuanzhang, led an armed rebellion against the newly crowned emperor Yuanwen.[13] In less than four years, Zhu Di's rebellion for succession ultimately prevailed against Yuanwen; Zhu Di assumed the title *Yongle* (Eternal Happiness) and began his reign as the third Ming emperor in 1402.[14] Emperor Yuanwen fled China in shamed exile; thereby remaining a constant threat to the legitimacy of the *Yongle* emperor's nascent regime.

Immediately upon assuming power, the *Yongle* emperor faced three significant challenges. First, China was facing dire economic conditions because of the economic strain induced by years of civil war and the Confucian policies of his two predecessors that despised merchants and banned international trade.[15] Second, the Ming dynasty was still vulnerable to attack and undue foreign influence from the neighboring countries of Japan, Korea, Mongolia, and Vietnam.[16] Last, the potential return of emperor Yuanwen and factions still loyal to his brand of traditional Confucianism threatened domestic tranquility.[17] Traditional Chinese society would need transformation if China were to take its place as a great nation in the world.

Emperor Zhu Di decided to address all of these problems simultaneously by instituting a tribute system.[18] Under this system, surrounding nations provided gifts to China in exchange for such benefits as military protection or exclusive trade rights. To provide a means to foster domestic unity, transform Chinese consciousness both at home and abroad, discredit the exiled emperor, and compel other

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[13] Robinson, "Banditry and the Subversion," 527.
[14] Chan Hok-lam, "Legitimating Usurpation: Historical Revisions under the Ming Yongle Emperor (r. 1402–1424)," *The Legitimation of New Orders: Case Studies in World History* (Chinese University Press, 2007), (Accessed 8 December 2012).
[15] Levathes. *When China Ruled the Seas, 73.*
[16] Gronewald, *The Ming Voyages*, 1.
[17] Levathes, *When China Ruled the Seas, 73.*
[18] Gronewald, *The Ming Voyages*, 1.

nations to agree with the tributary system, Zhu Di instituted a series of grand national projects designed to gloriously demonstrate China's power and reclaim honor. Many of these projects, such the Forbidden City, Grand Canal, and Great Wall, still stand as monuments to China's glory.[19] However, the crown jewel of these projects, the one responsible for ensuring the flow of tribute and projecting Chinese eminence overseas, was the construction of China's massive fleet of treasure ships.

The construction of the fleet was a major departure from traditional Chinese ideals. Traditionally, China considered itself as the privileged Middle Kingdom; a nation harmoniously suspended at the world's center with little need for interaction with nations outside its borders.[20] However, Zhu Di, not bound by the precepts of Confucian society, envisioned the importance of the society he wanted to create as overriding these concerns. He turned to a closely trusted advisor to lead this massive naval flotilla as the Ming dynasty's first envoy to the world.

The *Yongle* emperor entrusted Zheng He, a Chinese Muslim Eunuch and personal advisor, to lead a series of seven audacious naval expeditions from 1405 to 1433.[21] Ma Huan, a historian who traveled with Zheng He on several voyages and chronicled the expeditions on behalf of the emperor, best summarized the overarching purpose of this armada.

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[19] Patricia Buckley Ebrey, *The Cambridge Illustrated History of China*, (Cambridge, UK: Cambridge University Press, 1999) 194.
[20] Guy Oliver Faure, "China: New Values in a Changing Society," *China Europe International Business School*, http://www.ceibs.edu/ase/Documents/EuroChinaForum/faure.htm (Accessed 12 December 2012).
[21] Evan Hadingham, "Ancient Chinese Explorers," PBS NOVA, 16 January 2001, http://www.pbs.org/wgbh/nova/ancient/ancient-chinese-explorers.html (Accessed 1 December 2012).

> The Grand Exemplar The Cultured Emperor [Zhu Di] issued an imperial order that the principal envoy the Grand Eunuch Cheng Ho [Zheng He] should take general command of the treasure ships and go to the various foreign countries in the western ocean and read out the imperial commands and bestow rewards.[22]

In short, Zheng He's mission was to "show the flag" in a manner so spectacular as to cause other nations to yield in awe to the majesty and power of the Ming Empire. In so doing, Zheng He was also to spread Chinese culture abroad and to return to China important foreign dignitaries, unique artifacts, and valuable treasure to help transform Chinese society by enhancing consciousness of the outside world. To accomplish these goals, the *Yongle* Emperor commissioned a naval fleet of unprecedented scale and technological sophistication.

Figure 3: Routes for the Seven Expeditions of Zheng He

Source: "Thematic Maps," Map Illustrations, http://www.mapillustrations.com au/thematic_maps.html (Accessed 15 September 2012)

At up to 400 feet long, 160 feet wide, featuring nine masts, twelve sails, and a cargo capacity of over 2500 tons, Zheng He's *Bao Chuan* (Treasure Ships) dwarfed any naval vessels produced by any other nation or empire for the next 500 years.[23] For comparison, all three of the ships used for Christopher Columbus' famous expedition could fit

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[22] Ma Huan, *The Overall Survey of the Ocean's Shores[1433]*, trans J.V.G. Mills. (Cambridge, UK: Cambridge University Press, 1970), 177.
[23] Mark Dwinnells, "Lost Leviathans: The Technology of Zheng He's Voyages" Bridgewater State College Undergraduate Review, Vol. 4, 127.

inside the volume of a single *Bao Chuan.*[24] The Chinese fleet consisted of approximately 62 of these massive super ships, each outfitted with technological advances far beyond contemporary European designs, such as double hulls, navigational compasses, and a balanced rudder to enhance stability.[25] The *Bao Chuan* were accompanied by dozens of smaller craft designed to provide escort, serve as fresh water tankers, transport horses, and berth military soldiers. Supplies of fresh meat provided by supporting fishing vessels in the fleet, combined with fresh vegetables and fruits grown in potted plants aboard the *Bao Chuan* meant that Chinese sailors suffered scurvy and malnutrition at far less rates than their European counterparts. This feat is all the more impressive given the fact that Zheng He commanded a fleet of nearly 300 ships and over 30,000 men.[26] The dry docks at Longjiang alone required 20,000-30,000 men simply to build the fleet.[27] To outfit the ships for trade, the *Yongle* emperor ordered regional provinces to produce, "thousands of bolts of silk and cotton cloth, large supplies of iron, salt, hemp, tea, wine, oil,

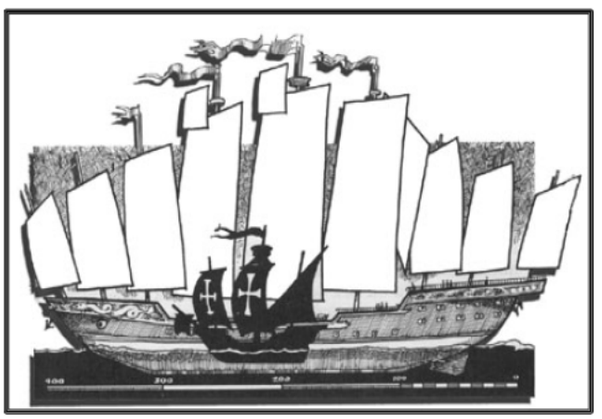

Figure 4: Treasure Ships vs. Portuguese Caravel

Source: "Zheng He (1371-1435) Admiral of the Treasure Ships," Al Rahalah, http://www.alrahalah.com/2010/09/zheng-he/ (Accessed 12 October 2012)

[24] Kahn, "China has an Ancient Mariner," (Accessed 10 December 2012).
[25] Levathes, *When China ruled the Seas,* 81.
[26] Adi Ignatius, "The Asian Voyage: In the Wake of the Admiral," Time Magazine, 20 August 2001, http://www.time.com/time/world/article/0,8599,2054421,00.html#ixzz2EiQtsbep (Accessed 11 November 2012).
[27] Dwinnells, "Lost Leviathans," 128.

and candles."[28] Failure to meet established quotas by the deadline resulted in fines and imprisonment.[29]

For nearly 27 years, China repeatedly dispatched this massive fleet to destinations along the South China Sea, Indian Ocean, and Red Sea. The fleet's use was pivotal in bolstering many important Chinese strategic goals, such as building political relationships within the Philippines, securing access to valuable spice exchanges in Calicut India, and opening up trade with Arab empires along the Strait of Hormuz.[30] The Ming Dynasty became deeply revered in nations as far west as Africa and Chinese culture became enriched by assimilating new knowledge, arts, and curious artifacts from exotic societies well beyond their own borders. The fleet traveled the equivalent distance of 7 ½ circumnavigations around the world and visited 40 countries.[31] At a time nearly 100 years before Christopher Columbus, China was significantly beyond European capabilities as the standard-bearer for state exploration.

However, the death of *Yongle* emperor in 1424 removed much of the political backing required to mount expeditions of such incredible scale and cost. The Confusion traditionalists returned to power with the fourth Ming emperor and the progressive Eunuch advisors to the imperial court lost favor.[32] The new emperor quickly derided fleet expeditions as expensive and heretical to the natural order of society. In addition to the turn of the political winds, China's population suffered a brutal famine and flooding along the Yellow River that further jeopardized any notions of investing resources in state exploration

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[28] Levathes, *When China Ruled the Seas,* 84.
[29] Levathes, *When China Ruled the Seas,* 84.
[30] Ignatius, "The Asian Voyage," (Accessed 11 November 2012).
[31] Ignatius, "The Asian Voyage," (Accessed 11 November 2012).
[32] Kristof, "1492," (Accessed 10 December 2012).

campaigns to far-flung destinations.[33] Following the return of the fleet in 1433 after the seventh expedition, the new emperor ordered the treasure ships sequestered to port and burned. Ming leadership imposed a ban on constructing ships with greater than two masts and limited the role of Chinese ships to coastal fishing.[34] In a zeal to re-impose Confucian order on society, the Ming Minister of Defense confiscated state records relating to Zheng He, declaring these documents as, "deceitful exaggerations of bizarre things far removed from the testimony of people's eyes and ears."[35] He added further, "the expeditions of [Zheng He] to the West Ocean wasted tens of myriads of money and grain and moreover the people who met their deaths may be counted in the myriads. Although he returned with wonderful precious things, what benefit was it to the state?"[36] Zheng He died at sea during the seventh and final voyage of the fleet in 1433.[37] The fifteenth century Confucian fervor to expunge Zheng He from China's history resulted in obscuring the accomplishments of the expeditions from Chinese society and the rest of the world until the late 1990s.[38] Only China's recent surge to world power status has elevated Zheng He within Chinese society as an inspirational model for reclaiming the Middle Kingdom's former glory.

While the grand expeditions of Zheng He were undoubtedly expensive to execute, the cost to China of seclusion from growing world competition proved significantly greater. Many scholars mark the destruction of the *Bao Chuan* as the ultimate symbol of China's return to devastating isolationism during a critical era of growing competition from foreign powers. By withdrawing back to the Middle Kingdom,

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[33] Gronewald, *The Ming Voyages*, 3.
[34] Gronewald, *The Ming Voyages*, 3.
[35] Gronewald, *The Ming Voyages*, 3.
[36] Gronewald, *The Ming Voyages*, 3.
[37] Ignatius, "The Asian Voyage," (Accessed 11 November 2012).
[38] Kristof, "1492," (Accessed 10 December 2012).

China leaders ceded crucial advances in cultural development and economic strength to Western nations and set the stage for domination by foreign powers for the next 500 years. The outright and sudden cancellation of all exploration voyages beyond China's shores, drastic curtailing of international trade and tribute, and self-destruction of its indigenous ship building industry isolated China from the dynamic capitalist movements revolutionizing Western economies.[39] Isolationism prevented China's ability to resist foreign intervention as well as spawned an illicit economic sea trade that enriched Chinese and Japanese pirates at the expense of the state. As evidence of this decline, China's share of world GDP fell from 30% in the late fourteenth century to less than 5% by the mid twentieth century.[40] Ironically, the Confucian advisors who tried to prevent China's demise by a return to traditionalism were the beginning architects of China's doom, not the progressive Eunuchs. In particular, one nation on the Iberian Peninsula was about to assume the mantle of state exploration excellence from China.

In Search of Christians and Spices…

The morning of 8 July 1497 dawned as a seminal moment in the Age of Discovery.[41] As the sun crested the horizon, a solemn crowd of men marched to the shores of the Tagus River in Lisbon Portugal. A small ensemble of priests and friars chanting litanies and carrying lighted candles escorted them along the dimly lit path.[42] Awaiting the procession at the shore were the *São Gabriel*, *São Raphael*, *São Miguel*, and a provisions ship; four Portuguese ocean going vessels specially

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[39] Angus Maddison, "China in the World Economy: 1300-2030," *International Journal of Business,* 11(3), (2006): 243.
[40] Maddison, "China in the World Economy,"
[41] Álvaro Velho & João de Sá, *A Journal of the First Voyage of Vasco Da Gama, 1497-1499,* trans E.G. Ravenstein, (London: Bedford Press, 1958), 1.
[42] Velho and de Sá, *First Voyage of Vasco Da Gama, 186.*

outfitted for an audacious mission.[43] Before boarding, the clergy absolved the sailors of their prior sins and offered prayers to God for their safe and prompt return. As explained by Álvaro Velho, eyewitness and chronicler of this voyage, this expedition of 170 men, led by explorer Captain-Major Vasco De Gama, sailed on behalf of King Dom Manuel to, "make discoveries and go in search of spices."[44] Unlike previous voyages, however, De Gama's mission was special as it represented the singular culmination of Portugal's multi-decade plan to achieve global superpower status. As the last ship gracefully sailed past Lisbon and disappeared out to sea, the crowd of clergy and well-wishers forlornly remaining on shore could only wonder what fate held in store for De Gama, his crew, and all of Portugal.

The Age of Discovery saga of Portugal, a nation that rocketed to brief prominence from the fringes of obscurity in less than a generation, begins by first understanding the fifteenth century geo-strategic context of the Iberian Peninsula. Portugal was, and still is, landlocked on three sides by Spain. In the fifteenth century, this geographic reality meant that the often-hostile monarchies of present day Spain and France could arbitrarily impose a stranglehold on European land commerce to Portugal.[45] Combined with the difficult logistical challenges to trade posed by the rugged terrain and lack of natural resources within the Iberian Peninsula, the growth of Portugal was stunted by the vulnerability of any potential land based trade route to Europe. In addition, Portugal, indeed all of Europe, was subject to the threat posed by the Moor's seemingly impenetrable control of the spice trade through

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[43] Glenn Ames, *The Globe Encompassed: The Age of European Discovery, 1500–1700* (Upper Saddle River, NJ: Prentice Hall, 2007), 27.
[44] Velho and de Sá, *First Voyage of Vasco Da Gama,* 1.
[45] K.G. Jayne,*Vasco De Gama and his Successors 1460-1580* (London: Methuen & CO LTD, 1910), 2.

the Mediterranean Sea and land routes to Asia.[46] Consequently, exorbitant fees paid to traffic in spices resulted in enriching the coffers and power of Moorish rulers at the expense of European nations.

For Portugal, however, these same challenges also strongly inclined Portuguese society to hinge its future upon maritime expansion into the Atlantic away from the Mediterranean Ocean and European continent. Portugal possessed nearly 300 miles of uninterrupted Atlantic coastline, featuring many deep sheltered ports and rivers that connected inland cities with the sea.[47] Furthermore, its close proximity and relative ease of access to the west coast of Africa gave Portugal a unique positional advantage compared to other European nations in the coming Age of Discovery. The leader most responsible for harnessing these geo-strategic dynamics and placing Portugal on the path to exploration preeminence was the famed Prince Henry the Navigator.[48]

Prince Henry, born the fourth son of King John I and Queen Phillipa in 1394, was renowned within the Portuguese monarchy for being, "a dreamer, a scholar, and a monk," with a mind for business and, "an initiative and dynamic will which enabled him to transmute his dreams into facts."[49] He is singlehandedly credited with financing and organizing several increasingly audacious expeditions south along the African

Figure 5: Prince Henry the Navigator

Source: University of South Florida, http://etc.usf.edu/clipart/25000/25010/henry_25010.htm (Accessed 15 August 2012)

[46] "A Short History of Spain and Portugal," Stanford University, http://aero-comlab.stanford.edu/jameson/world_history/A_Short_History_of_Spain_and_Portugal.pdf (Accessed 10 October 2012).
[47] Jayne, *Vasco De Gama,* 2.
[48] "Prince Henry the Navigator," *The Applied History Research Group-University of Calgary*, http://www.ucalgary.ca/applied_history/tutor/eurvoya/henry1.html (Accessed 5 September 2012).
[49] Jayne, *Vasco De Gama,* 10.

coast and establishing an institution in Sagres Portugal designed to advance the state of the art of naval exploration.[50]

Gomes Eannes de Azurara, a fifteenth century contemporary of Prince Henry and chronicler of Portuguese expeditions along Africa's Guinea coast, best summarized Prince Henry's motivations.

1. The development of a commercial and colonial empire to elevate Portugal to the wealthiest of European nations
2. Crusader zeal to expand Christendom through the heart of the Moorish empire[51]

Prince Henry understood that the surest path to accomplish these strategic goals was for Portugal to destroy the economic and spiritual power base of the Moors. His chosen ways to enact this strategy were twofold; 1.) Open an alternate sea-based spice trade route to Asia; and 2.) Form an alliance between European Christian kingdoms and the legendary Abyssinian Christian kingdom of Prester John, rumored at the time to be lost somewhere deep within the reaches of Moor controlled territory.[52] The means needed to support this strategy required developing and incorporating the latest advancements in shipbuilding and navigational technology.

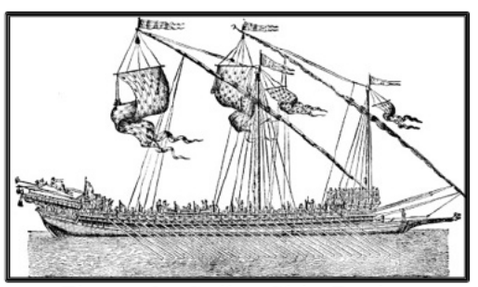

Figure 6: Galley Ship Design

Source: Pirate Ship, http://www.thepiratesrealm.com/pirate%20ship.html (Accessed 10 December 2012)

The galley, a type of ship propelled primarily by a large team of oarsmen, evolved since the second Millennium Before the Common Era (BCE) to become the

[50] "Prince Henry the Navigator," *The Applied History Research Group-University of Calgary*, (Accessed 5 September 2012).
[51] Gomes Eannes de Azurara, *The Chronicle of the Discovery and Conquest of Guinea,* trans. Charles Raymond Beazley (London: Bedford Press, 1896), v-vi.
[52] Robert Silverberg, *The Realm of Prester John* (Columbus, OH: Ohio University Press, 1996), 163-164.

principal vessel on the Mediterranean Ocean by the fifteenth century ACE.[53] The ship's lightweight design, narrow hull, and excellent maneuverability suited it well for maritime commerce and wartime missions within the relatively protected waters of the Mediterranean.[54] However, these same features made the galley's design ill adapted for long duration ocean voyages or operations in heavy sea states. For example, its heavy dependence on large food and water supplies to fulfill the high calorie requirements of oarsmen under constant labor limited the ship to relatively short duration trips within easy reach of port.[55] The navigational technology and skills required to sail galleys in the Mediterranean was relatively minimal compared to that required for long duration open ocean voyages. Furthermore, large open ports along the galley's hull, designed to accommodate rows of oars, also made the vessel susceptible to swamping in high seas.[56] The deck space needed to accommodate between 150 to 200 oarsmen also limited the galley's cargo hold capacity and armament options.[57] Hence, while ocean going trips in galley type designs were possible, as proven by the epic thirteenth century voyages of the Vikings to the North American continent, they were also cumbersome and inefficient. For exploration campaigns on the scale of Prince Henry's ambition, a much-improved class of ship would be required.

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[53] Shelley Wachsmann, "Paddled and Oared Ships Before the Iron Age," in *The Age of the Galley: Mediterranean Oared Vessels Since Pre-Classical Times,* John S. Morrison & Robert Gardiner (London: Conway Maritime, 1995), 10–25.
[54] John Law, "Technology and Heterogeneous Engineering: The Case of Portuguese Expansion," in *The Social Construction of Technological Systems,* Wiebe E. Bijker, Thomas P. Hughes and Trevor Pinch (Cambridge, MA: MIT Press, 1989), 115.
[55] Law, "Technology and Heterogeneous Engineering," 116.
[56] John H. Pryor, "From dromon to galea: Mediterranean bireme galleys AD 500-1300," in *The Age of the Galley: Mediterranean Oared Vessels Since Pre-Classical Times,* John S. Morrison & Robert Gardiner (London: Conway Maritime, 1995), 71-75.
[57] Law, "Technology and Heterogeneous Engineering," 116.

To overcome these technology challenges, Prince Henry led the use and advancement of the caravel long sailing ship. In particular, the advanced hull design of caravels enabled a number of innovations. The Portuguese pioneered a construction technique, known as carvel planking, which featured stronger keel ribs that could support sturdier sail riggings and increased hull volumes compared to previous vessel designs.[58] Caravel designers took advantage of this stronger hull construction by equipping these ships with multiple masts draped with tremendously sized square and lateen (triangular shaped) sails.[59] Specifically, the lateen sails allowed caravels to sail in directions facing upwind that were difficult for other ships, while the square sails gave the caravel great speed when sailing downwind.[60] By relying upon square and lateen sails as the primary means of propulsion, the crew size required to sail a caravel was approximately 24; nearly one order of magnitude less than the 150 to 200 crewmembers required to operate a similar-sized galley.[61] Decreased crew size combined with greater hull internal volume resulted in greater storage space for long duration supplies. Furthermore, the caravel's stronger hull design allowed safer operations in open ocean swells, improved damage resistance from enemy attacks, and allowed carriage

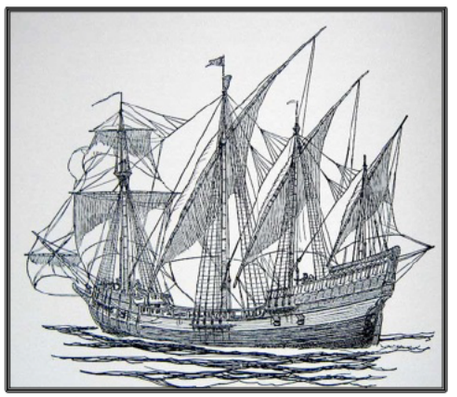

Figure 7: Fifteenth Century Caravel Design

Source: Celtic Twilight, http://www.celtic-twilight.com/charlemagne/art/bulfinch/caravel.htm (Accessed 13 November 2012)

[58] Brian Lavery, *Arming and Fitting of British Ships of War 1600-1815* (Annapolis, MD: Naval Institute Press, 2006), 212.
[59] I. C. Campbell, "The Lateen Sail in World History," *Journal of World History Vol. 6*, No. 1 (Spring, 1995): 1.
[60] Campbell, "The Lateen Sail," 1.
[61] Martin M. Elbi, *The Portuguese Caravel and European Shipbuilding: Phases of Development and Diversity* (Lisbon, PT: University of Coimbra, 1985), 552.

of armaments superior to adversary ships of lesser design.[62] This feature became especially important to the success of the caravel once standoff ship mounted cannon made ramming and boarding obsolete forms of naval warfare. While the wider and sturdier hull of the caravel made the ship harder to maneuver in close combat compared to a galley, these same features made the ship an excellent gunnery platform to mass broadside firepower. In addition to open ocean exploration, a caravel could operate adeptly in the shallow waters of inland rivers and coastlines due to the shallow draft and flat bottom design of its hull.[63]

Portugal also pioneered the development of ship compasses, naval charts, astrolabes, and astronomical star sighting techniques to help accurately determine latitude when far from shore.[64] These developments, coupled with the caravel, allowed Portugal to exploit the discovery of the Volta; a wind and sea current pattern in the mid-Atlantic that connected destinations in Africa with the Iberian Peninsula.[65] Collaboratively, these advances in navigational techniques, vessel design, and knowledge of weather conditions allowed Portuguese explorers to travel increasing distances along the African west coast while building confidence in their ability to return safely and efficiently home when desired.

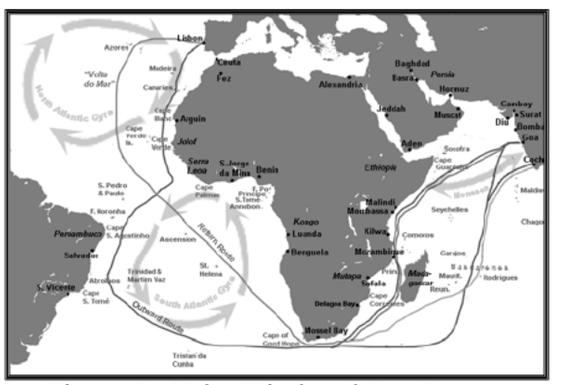

Figure 8: Volta Wind and Sea Current Pattern

Source: Walrasaid, http://en.wikipedia.org/wiki/File:Map_of_Portuguese_Carreira_da_India.gif (Accessed 15 December 2012)

[62] Law, "Technology and Heterogeneous Engineering," 128.
[63] Law, "Technology and Heterogeneous Engineering," 121.
[64] Law, "Technology and Heterogeneous Engineering," 122-126.
[65] Law, "Technology and Heterogeneous Engineering," 119.

From 1415 onward, Prince Henry leveraged these advancements to sponsor a series of Portuguese expeditions along the Guinea coast of Africa; each using the previous voyages' accomplishments and discoveries as springboards for the next expedition.[66] Portugal continued these exploration campaigns, even following Prince Henry's death in 1460, in order to secure toeholds within the emerging trade of African slaves, precious metals, ivory, and jewels.[67] Nonetheless, the true prize for Portugal remained domination of the Moorish trade in spices. The catalyst to achieve this goal arrived with the breakthrough expedition of Portuguese explorer Bartolomeu Dias.

In August of 1487, Dias set sail from Lisbon with two caravels under orders from King John II to find the "way around Africa" as well as confirm reports the king recently received concerning sightings of Prester John in Africa.[68] By the time the expedition returned in 1488, Dias explored nearly 1250 miles of African coastline that were previously unknown to the Portuguese.[69] More importantly, Dias established the latitude of the southern tip of Africa and discovered that the east coast of Africa beyond what Dias ominously christened as the "Cape of Storms" tracked far away to the northeast.[70] The news reported by Dias so elated the Portuguese monarchy that King John II renamed Dias' Cape of Storms to the Cape of Good Hope.[71] While he never found Prester John, the evidence from Dias' voyage strongly indicated to Portugal's crown the existence of a viable sea route to India. Were it not for the death of King John II in 1495 and continuous skirmishes with the neighboring French and Spanish monarchies, the Portuguese may have acted on this knowledge far sooner than the decade long gap

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[66] Jayne, *Vasco De Gama,* 24.
[67] Jayne, *Vasco De Gama,* 24.
[68] Azurara, *Discovery and Conquest of Guinea*, xxxii.
[69] Jayne, *Vasco De Gama,* 28.
[70] Jayne, *Vasco De Gama,* 27-28.
[71] Ronald H. Fritze, *New Worlds: The Great Voyages of Discovery 1400-1600* (Westport, CT: Praeger Publishing, 2002) 95.

between the expeditions of Dias and De Gama indicates.[72] Nonetheless, within three years of King Manuel's succession to the throne, Portugal resumed its maritime conquest with vigor. The task fell to explorer Vasco De Gama, an expert mariner and navigator with a sterling record of state service in protecting Portuguese trading stations along the African coast from the French.[73] For the state, the epic of De Gama's mission to India became the embodiment of Portugal's long struggle for global ascendency.

Figure 9: Vasco De Gama

Source: University of South Florida, http://etc.usf.edu/clipart/14700/14717/gama_14717.htm (Accessed 10 November 2012)

Despite the excellent pathway blazed by previous explorers, De Gama's expedition was extraordinarily arduous. For example, De Gama's voyage to the midway point at the tip of Africa resulted in his ships sailing for three months away from site of land and covering a distance of 6000 miles using the Voltas.[74] This endurance record exceeded the previous record, held by Christopher Columbus for his journey to the new world, by nearly two and half times.[75] After spending nearly four months in the ports of present day Mozambique and Kenya to restock his ships and hire a native pilot familiar with the weather currents of eastern Africa, De Gama cast off for a month long voyage across the Indian Ocean to his final destination.[76]

After a total travel time of 10 months and two weeks, De Gama's expedition finally arrived in the trade city of Calicut India on 21 May 1498.[77] The greeting the crew received from local Moors, however,

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[72] Jayne, *Vasco De Gama,* 33.
[73] Velho and de Sá, *First Voyage of Vasco Da Gama,* xiv.
[74] Bailey Wallys Diffie & George Davison Winius, *Foundations of the Portuguese Empire: 1415-1580* (St Paul, MN: University of Minnesota Press, 1977), 177-178.
[75] Jayne, *Vasco De Gama,* 33.
[76] Velho and de Sá, *First Voyage of Vasco Da Gama,* 196-198.
[77] Jayne, *Vasco De Gama,* 52.

foreshadowed the turbulent relationship in store between Portugal and India. As described by the firsthand account of Álvaro Velho,

> The first greeting that he [De Gama's envoy] received was in these words, "May the Devil take thee! What brought you hither?" They asked what he sought so far away from home, and he told them that we came in search of Christians and of spices.[78]

The Malabar king in Calicut held court several times with the strange visitors from the Iberian Peninsula. Both parties exchanged letters and gifts of good will while cautiously trying to determine the other's true intentions. Through interpreters, De Gama inquired about Christians living within the city and endeavored to establish a Portuguese trade house for spices.[79] In turn, the Malabar king tried to determine what resources Portugal possessed that could be of any worth to Calicut.[80] Within weeks, however, hostility from local Moors precipitated a collapse of trade and cordiality between De Gama and the Malabar king. Both sides captured and exchanged hostages in a brinksmanship show of strength to force trade concessions from the other.[81] By 30 August, relations had soured to the point that De Gama and his ships hastily left Calicut's port while firing canons at a hostile flotilla of 70 small boats in hot pursuit.[82]

The trip home proved no less difficult as De Gama's hasty departure placed him opposite the prevailing Indian Ocean Monsoon winds; nearly tripling his return time to reach Africa from one to three months and straining the expedition's meager supplies.[83] Thirty crewmembers lost their lives to starvation and scurvy. Illness crippled

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[78] Velho and de Sá, *First Voyage of Vasco Da Gama,* 48.
[79] Velho and de Sá, *First Voyage of Vasco Da Gama,* 55-63.
[80] Velho and de Sá, *First Voyage of Vasco Da Gama,* 55-63.
[81] Velho and de Sá, *First Voyage of Vasco Da Gama,* 75-76.
[82] Velho and de Sá, *First Voyage of Vasco Da Gama,* 77.
[83] Álvaro Velho & João de Sá, *A Journal of the First Voyage of Vasco Da Gama, 1497-1499,* 87.

the remaining crewmembers such that only six to seven sailors per ship were fit for duty by the time the expedition reached Kenya.[84] De Gama burned one of his caravels, as he no longer possessed sufficient crew to operate all three ships.[85] In addition, De Gama paid a personal price in that the hellish return trip to Portugal eventually claimed the life of his brother, Paulo De Gama.[86] Ultimately, De Gama lost nearly two-thirds of his initial crew.[87]

Nonetheless, De Gama and his surviving crew returned as heroes when they limped back to Lisbon by September of 1499.[88] The pepper and cinnamon spices within the cargo holds of the remaining two ships sold for several times the cost of the entire expedition; making De Gama's voyage extravagantly lucrative for Portugal.[89] For opening a spice route to India, De Gama was eventually granted the title Dom (Lord), received a sizable pension for himself and his family, and was christened by the monarchy as the Admiral of Seas of Arabia, Persia, and India.[90] King Manuel, in a letter to the Castile monarchy, described the geo-strategic significance of the voyage for all of Europe.

> The Christian people whom these explorers reached are not as yet strong in the faith, nor thoroughly conversant with it. But when they shall have been fortified in the faith, there will be an opportunity to destroy the Moors of those regions. Moreover we hope, with the help of God, that the great trade which now enriches those Moors . . . shall be diverted to the natives and ships of our own realm.[91]

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[84] Jayne, *Vasco De Gama,* 58.
[85] Jayne, *Vasco De Gama,* 58.
[86] Jayne, *Vasco De Gama,* 58.
[87] Jayne, *Vasco De Gama and his Successors 1460-1580,* 59.
[88] Sanjay Subrahmanyam, *The Career and Legend of Vasco da Gama* (New York: Cambridge University Press, 1997), 225.
[89] Subrahmanyam, *Career and Legend of Vasco da Gama*, 225.
[90] Subrahmanyam, *Career and Legend of Vasco da Gama*, 18.
[91] Velho and de Sá, *First Voyage of Vasco Da Gama,* 114.

Two subsequent expeditions returned to India, the second led by Pedro Cabral and the third again by De Gama.[92] Based on the experience of the first expedition, however, these voyages featured significantly larger military armadas designed to enforce Portuguese control of the Indian Ocean by sinking rival trader ships, bombarding Indian coastal ports into submission, and establishing trade hubs to assure access to the spice markets.

Vasco De Gama's expedition set Portugal on the path to domination of the extraordinarily lucrative Indian spice market trade. Unfortunately, mismanagement by Portugal's economic and political elite meant that the nation was unable to capitalize on this initial advantage. Portugal's bask was to be relatively short lived. Less than 100 years after De Gama's first voyage, Portugal's grip on the spice trade weakened due to overextension and obsolescence of limited naval resources, attrition from the plague, political corruption, and squandered wealth.[93] These flaws made Portugal an inviting target for Spanish military invasion in 1580.[94] Due to these factors, Portugal was not able to check the rise of Dutch power. By 1595, the first Dutch ships rounded the Cape of Good Hope bound for India and by 1602, the Dutch incorporated the East India Company.[95] The British East India Company soon followed. Spice traders eventually bypassed ports in Lisbon for Antwerp, as it was the cheapest path to access valuable trading markets in Europe.[96] Portugal's rise as the economic hub of Europe was over.

Despite not being the lynchpin to crush the Moors and unite Christendom, the expedition of De Gama is widely regarded as one of

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[92] Jayne, *Vasco De Gama,* 62.
[93] Jayne, *Vasco De Gama,* 285.
[94] Jayne, *Vasco De Gama,* vi & 278.
[95] Robin Donkin, *Between East and West: The Moluccas and the Traffic in Spices Up to the Arrival of Europeans* (Philadelphia, PA: Diane Publishing Company, 2003), 169.
[96] Jayne, *Vasco De Gama,* 287-288.

the great exploration campaigns of history. The Portuguese commissioned many monuments around the port of Lisbon in De Gama's honor. For its time, the voyage was an amazing accomplishment of navigational skill and rapid technology development. Unquestionably, these voyages catapulted Portugal to the highest echelon of state power during the early stages of the Age of Discovery.

While expeditions similar to De Gama are common throughout history, not all explorations fit this model. Some spark by a simple quest to attain honor and transcend the human condition through the act of accomplishing seemingly impossible feats.

Lands of Ice in the South…

At the sixth annual International Geographical Conference, held in London in 1895 and sponsored by the Royal Geographical Society, one man's captivating presentation spurned a new era of exploration.[97] On stage was Carsten Borchgrevink, a Norwegian explorer. His paper, entitled "Voyage of the '*Antarctic*' to Victoria Land," described his brief excursion aboard a whaling ship to a stark, unexplored continent sheltered behind the treacherous ice flows of the Southern Ocean.[98] While explorers knew of the potential existence of a continent at the South Pole for many years, Borchgrevink's account captivated the audience because of his singular distinction of being the first human to set foot on the mysterious territory. Landing at Cape Adare, a point near today's famous McMurdo Research Station, Borchgrevink observations electrified the conference because of their implications for exploration.

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[97] Carsten Borchgrevink, *First on the Antarctic Continent* (George Newnes Ltd, 1901), 4-5.
[98] Borchgrevink, "Voyage of the 'Antarctic'," 169-176.

> I made a thorough investigation of the landing place because I believe it to be a place where a future scientific expedition might safely stop even during the winter months. Here the unbound forces of the Antarctic Circle do not display the whole severity of their powers. Neither ice, nor volcano seemed to have raged at the peninsula at Cape Adare and I strongly recommend a future scientific expedition to choose this spot as a centre for operations. At this place there is a safe situation for houses, tents, and provisions.[99]

The society unanimously agreed with him declaring, "this [Antarctica] was the greatest piece of geographical exploration still to be undertaken."[100] The society then urged scientific communities worldwide by stating, "this work should be undertaken before the close of this century."[101] Thus was born the Heroic Age of Antarctic Exploration; a quixotic era of state exploration best personified by the race to the South Pole between Norway's Roald Amundsen and Great Britain's Captain Robert Falcon Scott.

The British announced Captain Scott, a serving officer in the Royal Navy, as commander of the Antarctica expedition on 13 September 1909.[102] Captain Scott was no stranger to polar exploration, having achieved national notoriety for his leadership of the 1902 British survey of Antarctica in which his team came within 480 miles of the South Pole.[103]

Figure 10: Captain Robert Falcon Scott

Source: The Royal Collection, http://www.royalcollection.org.uk/egallery/object.asp?maker=13292&object=661277&row=0 (Accessed 5 September 2012)

Known for his sense of daring and scientific mind, Scott's strong political

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[99] Borchgrevink, "Voyage of the 'Antarctic'," 174.
[100] Borchgrevink, "Voyage of the 'Antarctic'," 176.
[101] Borchgrevink, "Voyage of the 'Antarctic'," 176.
[102] Robert Falcon Scott, *Robert Falcon Scott's Journals: Captain Scott's Last Expedition*, (Oxford, UK: Oxford University Press, 2005), xxv.
[103] Scott, *Robert Falcon Scott's Journals*, xxii.

connections within the esteemed Royal Geographical Society helped him secure a £20,000 grant from the British government; approximately 50% of the total cost of the entire expedition.[104] Scott explained that the purpose of his journey was, "an outward visible sign that we [Great Britain] are still a nation able and willing to undertake difficult enterprises, still capable of standing in the van of the army of progress."[105] However, rather than a pure assault on reaching the pole, Scott's expedition was additionally commissioned to carry out a wide variety of scientific research along the Antarctic continent. As a result, Scott's expedition of 65 men, selected from over 8000 applicants, featured eminent researchers in the fields of meteorology, biology, zoology, and physics.[106] On 15 June 1910, the historic British expedition officially embarked from the southern English port town of Cardiff aboard the *Terra Nova*; a converted whaling ship specially outfitted for the harsh conditions of the Southern Ocean.[107]

Figure 11: Roald Amundsen

Source: Britannica, http://www.britannica.com/EBchecked/media/8092/Roald-Amundsen-1923 (Accessed 10 November 2012)

Great Britain's main competition came from Norway's Roald Amundsen. Amundsen was an avid outdoorsman inspired by Norwegian explorer Fridtjof Nansen's expedition across Greenland.[108] In 1899, Amundsen established polar experience and credibility through his

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[104] "Captain Scott's British Antarctic (Terra Nova) Expedition 1910 - 1913," *Antarctic Heritage Trust*, http://www.nzaht.org/AHT/HIstoryEvans/ (Accessed 15 October 2012).
[105] Scott, *Robert Falcon Scott's Journals*, xxxii.
[106] Leonard Huxley, *Scott's Last Expedition, Volume II: Being the reports of the journeys and the scientific work undertaken by Dr. E.A. Wilson and the surviving members of the expedition* (London: Smith, Elder & Co., 1913) 498; and "Captain Scott's British Antarctic (Terra Nova) Expedition," (Accessed 15 October 2012).

[107] Scott, *Robert Falcon Scott's Journals*, xxvi.
[108] Roald Amundsen, *The South Pole: An Account of the Norwegian Antarctic Expedition in the 'Fram' 1910-1912,* trans. A.G. Chater (New York: The Trow Press, 1913), 13-15.

service aboard the *Belgica*; the first ship to locate the Earth's southern magnetic pole and overwinter in Antarctica.[109] He also achieved fame for Norway in 1906 aboard the sloop *Gjøa* for leading the first successful navigation of the elusive Northwest Passage between the Atlantic and Pacific Oceans.[110] By September of 1909, Amundsen was completing preparations for a Norwegian expedition to be the first at the North Pole until Admiral Robert Peary claimed that prize for America.[111] Amundsen wrote, "Just as rapidly as the message had travelled over the cables I decided on my change of front—to turn to the right-about, and face to the South."[112] To prevent usurpation, Amundsen kept his change of destination and final preparations secret. The day before embarking aboard the *Fram*, Amundsen's expedition received a special sendoff visit from Norway's King Haakon VII and Queen Maud. Amundsen was visibly moved by this public gesture of support from Norway's royalty and explained in his journal, "I am sure that every one of the *Fram's* crew will always remember with respectful gratitude King Haakon's cordial words of farewell."[113] The *Fram* left on its momentous journey through the fjords south of Oslo on 3 June 1910; barely two weeks ahead of the departure of Britain's *Terra Nova*. Finally underway, the veil of secrecy no longer required, Amundsen dispatched a surprise telegram to Captain Scott, "BEG TO INFORM YOU *FRAM* PROCEEDING ANTARCTIC—AMUNDSEN."[114] As evidenced by the late notice of the telegram, the only goal of Amundsen's expedition for Norway was to be first to the pole.

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[109] *The Houghton Mifflin Dictionary of Biography* (Boston, MA: Houghton Mifflin Harcourt, 2003), 43.
[110] Amundsen, *The South Pole,* 13.
[111] Amundsen, *The South Pole,* 13.
[112] Amundsen, *The South Pole,* 13.
[113] Amundsen, *The South Pole,* 46.
[114] "Captain Scott's British Antarctic (Terra Nova) Expedition," (Accessed 15 October 2012).

Upon reaching Antarctica, the differences in technology and expedition focus became immediately apparent. For example, Amundsen's expedition made camp at the Bay of Whales approximately 400 miles east of Scott's camp at Ross Island.[115] By default, this choice of starting location shortened Amundsen's round trip to the pole by 60 miles as compared to the route chosen by Scott. In addition, Amundsen's reliance upon Eskimo dogs for sledge propulsion proved a superior choice to Scott's use of Manchurian ponies and experimental motor sledges. Scott laced his journal with details of how the extreme conditions caused both the ponies and motor sledges to fail him; ultimately slowing his team down and stretching limited resources as they "man-hauled" supplies.[116] In contrast, the Eskimo dogs of Amundsen's voyage were adaptable to any terrain, lightweight enough to be easily pulled out of crevasses, able to serve as a food source for other dogs and expedition members, and sufficiently powerful enough to pull sledges even as their numbers dwindled along the journey.[117] Last, Amundsen's sole focus on reaching the pole freed his expedition from taking the numerous scientific observations that encumbered Scott's team on its journey.[118]

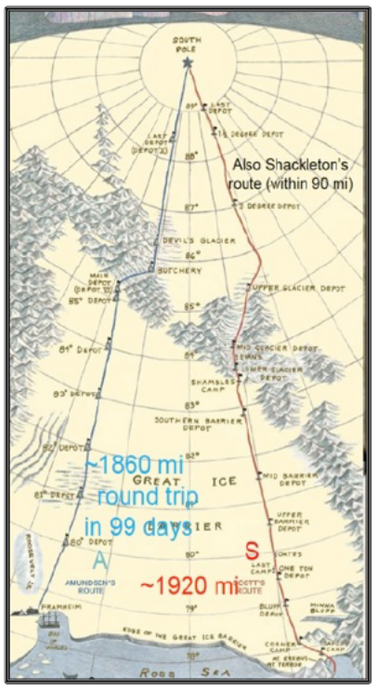

Figure 12: Routes of Amundsen and Scott Expeditions

Source: University of California Santa Barbara, www.opl.ucsb.edu/tommy/pubs/Nansen_Talk_

[115] Scott, *Robert Falcon Scott's Journals*, xxivi; and Amundsen, *The South Pole,* 55.
[116] Scott, *Robert Falcon Scott's Journals*, 77 & 137-138.
[117] Amundsen, *The South Pole,* 36.
[118] "Roald Amundsen – Pole to Pole Norwegian Explorer," *University of California Santa Barbara-Nordic Spirit Symposium*, February 2011,

Amundsen's team left base camp on 20 October 1911, 11 days in front of Scott's departure on 1 November 1911.[119] However, because of these differences in approach, Amundsen's team eventually extended its lead over Scott's team to 33 days; reaching the pole first on 14 December 1911.[120] Upon arriving, Amundsen remarks captured the pride and patriotism realized for Norway in that moment.

Figure 13: Amundsen's Expedition at the South Pole

Source: http://www.southpolestation.com/trivia/igy2/tent1.html (Accessed 15 December 2012)

> Five weather-beaten, frost-bitten fists they were that grasped the pole, raised the waving flag in the air, and planted it as the first at the geographical South Pole. "Thus we plant thee, beloved flag, at the South Pole, and give to the plain on which it lies the name of King Haakon VII's [Norway's King] Plateau." That moment will certainly be remembered by all of us who stood there. [121]

Amundsen's team completed the round trip journey back to the Antarctic coast on 25 January 1912 having traveled 1,860 miles in 99 days with no fatalities or otherwise serious incidents.[122] The same fortune did not bless Scott's expedition.

Upon arriving at the pole on 14 January 1912 and witnessing the remains of the Norwegian camp, Scott dejectedly recorded in his journal, "The worst has happened…All the daydreams must go…Great God! This

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www.opl.ucsb.edu/tommy/pubs/Nansen_Talk_NHS2_pdf.pdf (Accessed10 December 2012).

[119] "Roald Amundsen," (Accessed 10 December 2012).

[120] Amundsen, *The South Pole,* 170.

[121] Amundsen, *The South Pole,* 171.

[122] "Roald Amundsen," (Accessed 10 December 2012).

is an awful place and terrible enough for us to have labored to it without the reward of priority."[123] Unfortunately, this was but one of several tragedies that would seal the expedition's doom. On the return trip, deteriorating weather, the inability to find supply caches, team exhaustion, and poor health resulted in a slow, agonizing fight for survival. Two of the five members of Scott's team died en-route back to base camp from injuries and exposure to the elements.[124] The remaining three struggled forward against the elements for as long as they could before collapsing into a tent, fatigued and bewildered, to await the inevitable. Scott's haunting final journal entry, dated 29 March 1912 and entitled "Message to the Public," best summed up the legacy of this voyage of exploration for Great Britain.

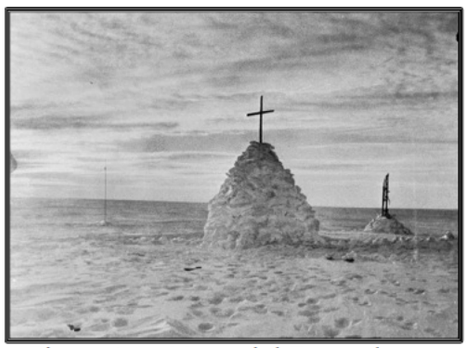

Figure 14: Memorial Erected over Final Resting Spot of Scott Expedition

Source: National Library of New Zealand, http://schools.natlib.govt.nz/culture-identity-heritage/primary-sources/gallery/antarctica/site-robert-falcon-scotts-tent-unknown- (Accessed 1 December 2012)

> We are weak, writing is difficult, but for my own sake I do not regret this journey, which has shown that Englishmen can endure hardships, help one another, and meet death with as great a fortitude as ever in the past.[125]

Eight months later, a recovery team discovered their three corpses, along with Scott's journal, huddled and frozen together under the collapsed roof of a makeshift tent.[126]

In a unique sense, both expeditions accomplished much to boost the respective honor of Norway and Great Britain. Photos of

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[123] Scott, *Robert Falcon Scott's Journals*, 376.
[124] "Captain Scott's British Antarctic (Terra Nova) Expedition," (Accessed 15 October 2012).
[125] Scott, *Robert Falcon Scott's Journals*, xxxi.
[126] "Captain Scott's British Antarctic (Terra Nova) Expedition," (Accessed 15 October 2012).

Amundsen's team standing proud at the South Pole not only electrified Norwegian pride, but also provided a transcendent image of inspiration for all of humankind. News of Scott's death similarly galvanized Great Britain in collective respect of a fallen hero. Scott's stoic approach to death, beautifully written journal, and heartfelt plea to his fellow citizens brought pride to a nation on the verge of dynastic decline. It became a source of rallying strength amidst the hardships Great Britain's citizens would endure during World War I. Polar expedition historian Roland Huntford best encapsulated both explorers impact on their respective countries when he wrote, "It was Scott who had set out to be a heroic example. Amundsen merely wanted to be first at the Pole. Both had their prayers answered."[127]

Conclusions

The sagas of Admiral Zheng He, Vasco De Gama, and the South Pole race between Amundsen and Scott represent some of the most significant exploration events throughout history. These three vignettes, broadly spread from fifteenth century China to twentieth century Great Britain, represent the significant themes underlying modern state exploration. As such, the information presented in chapter 1 serves as the foundational data set with which to construct the Exploration Model presented in chapter 2.

[127] "Captain Scott's British Antarctic (Terra Nova) Expedition," (Accessed 15 October 2012).

Chapter 2

A MODEL FOR EXPLORATION

Conceptualizing the Ethos of State Exploration Motivation

What's past is prologue.

William Shakespeare, 1610

All models are wrong, but some are useful.

George E.P. Box, 1979

Chapter 1's survey of historic state exploration campaigns reveals the constant dichotomy between the idealism of discovery and the pragmatism of urgent national security needs. The three vignettes of the previous chapter are representative of a major state exploration theme often touted within this dichotomy. Truly, those who approach exploration for its pragmatism and those who champion exploration for its idealism are both correct; both viewpoints, however, are also incomplete. All state exploration campaigns feature a delicate symbiosis of these two major forces.

Ultimately, the genesis of a state exploration campaign begins in the pursuit of grand strategy. As originally explained by military strategist B.H. Liddell Hart, grand strategy's role is to, "co-ordinate and direct all the resources of a nation, or band of nations, towards the attainment of the political object of the war—the goal defined by fundamental policy."[1] Grand strategy uses a holistic mix of all instruments of national power (diplomatic, information, military, economic) to seek an enduring and better state of peace for a state long

[1] B.H. Liddell Hart, *Strategy* (London: Meridian, 1991), 322.

past the conclusion of conflict.[2] This dissertation adapts the scope of Hart's original definition to focus on the act of state sponsored exploration in grand strategy instead of pure state versus state warfare. Viewed from this staring point, states often turn towards exploration, much like the act of war, as a potential way to fulfill grand strategic objectives. In similar fashion to war, the object of exploration must serve a state's overarching policy goals; whether those goals are mainly pragmatic, predominantly idealistic, or some mixture between these two viewpoints. Like war, the actual results of an exploration campaign are often wildly different from the original plans of the state. Since this research is for use in illuminating the possibility, motivations, and probable nature of human spaceflight's role within US grand strategy, this study focuses upon understanding original state intentions for exploration given the overarching geo-strategic context of an era. While explorations may ultimately fail in their original purpose, understanding why states turn to exploration at the outset in hopes of achieving strategic success is of important predictive value for strategists envisioning future explorations.

Studying state exploration from this perspective requires an analytical model that synthesizes the two viewpoints of idealism and pragmatism, highlights the impact of exploration upon the societies that embark upon them, and warns of the perils of overreach. With respect to the space age, this model is central for understanding the previous 50 years of human spaceflight exploration and is useful for developing a strategy to ensure America's future leadership. An important step in building this model is to understand the factors that set the necessary and sufficient conditions for state exploration to occur.

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[2] Hart, *Strategy*, 338.

State Exploration's Necessary and Sufficient Conditions

This study defines exploration as the deliberate act of venturing into and investigating the uses of a relatively unknown domain; these domains define as air, sea, land, cyber, or space. The prize of exploration is to find new resources, acquire potentially important knowledge, accrue unique advantages, or achieve accolades. While individuals or private organizations explore in accordance with their own personal beliefs or founding charters, this study is solely concerned with the factors that motivate states to perform this action. Based on this definition and the evidence provided by the vignettes of the last chapter, two necessary conditions emerge as requirements for exploration to occur.

First, exploration requires the existence of a frontier. The great physical presence and mystery of a novel frontier is vital for igniting society's innate curiosity for new knowledge, encouraging innovative exploits of the new domain, and satisfying the need to uncover potential dangers lurking beyond the veil of the unknown. Frontiers are regions or exploits that are unknown to all of humankind, as well as regions or exploits unexplored by individual states despite the efforts of other nations. Vast oceans and far-flung unexplored continents were the major frontiers of yesteryear; space is the major frontier of today. Once exploration transforms the mysterious into the familiar and the quest for innovative uses of a domain cease, the frontier becomes the routine and the case for exploration wanes.

Second, exploration requires supporting resources and technological development. In many cases, a technological breakthrough enables the drive to explore the unknown. Hence, while the existence of a frontier may be well acknowledged by a state, there exists only unique moments in which a frontier suddenly emerges as

viable for exploration due to a unique confluence of resources and technology. For instance, Portugal's need to spread Christianity as well as break the Moors' economic hold on the spice trade drove Vasco De Gama's expeditions to explore a sea route to India. However, this exploration campaign would not have been possible without Portugal's ship building resources and ocean access combined with a concerted effort to develop the ocean going caravel ship and advanced navigational technologies. Likewise, the fourteenth century desires of the Ming dynasty to transform Chinese society and extract tribute from nations as far west as Africa fueled the seven epic naval expeditions of Admiral Zheng He. The success of these expeditions greatly depended on the technology development and massive resources needed to construct and operate the mammoth *Bao Chuan* of China's fleet; the largest vessels in the world for the next 500 years. Once resources and technologies combine in this nature, they can become the basis for great exploration advantage.

However, simply having these two necessary conditions does not ensure exploration will occur. The missing sufficient condition, the factor that ultimately determines the nature of the resulting exploration campaign, is the state's perception of the risk of competition posed by challengers. This dynamic endows the knowledge, advantage, resource, or accolade sought by a state with a special value and temporal criticality; it spurns and focuses a state into action out of the realization that it may plausibly lose the tangible and intangible spoils of exploration to competitors. As demonstrated by the South Pole race between Great Britain and Norway, this competition between states does not necessarily need to be hostile in nature, only credible in both capability and intent.

How a state perceives this risk is rooted within its strategic culture. As described by strategist Colin Gray, strategic culture is what

a state has, "taught itself about itself and its relevant contexts."[3] Essentially, strategic culture helps shape how a state behaves and thinks and roots deep within a state's unique history and geography.[4] For example, Portugal's geographic encirclement by difficult terrain, history of conflict and humiliation at the hands of neighboring rivals, and abundant access to the sea drove a strategic culture predetermined to embrace exploration via the ocean as a path to dominance. As such, Portugal perceived the risk of falling behind other powers in this endeavor as too grave to ignore. Likewise, Norway's excellent geographic access to the ocean, extremely cold and rugged climate, and fascination with the mystique and accomplishments of intrepid Nordic explorers, made Antarctica a natural target for exploration. Hence, strategic culture, whether applied from a pragmatic or idealistic standpoint, is an important lens through which a state views risk.

Within this light, low competition risk defines as competition for resources or accolades that the state deems of minor or peripheral significance given its strategic culture and overarching geo-strategic context. Medium competition risk implies resources or accolades that the state perceives as important to national security, but not of such vital importance that the survival of the state depends upon achieving them. High competition reserves for resources or accolades the state believes are existential. Generally, the more substantial a state assesses this competition risk, the more focused and resourced exploration campaign efforts become.

These necessary and sufficient conditions are the independent variables to the equation of state exploration. The nature of a state's

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[3] Colin S. Gray, *Out of the Wilderness: Prime Time for Strategic Culture*, Defense Threat Reduction Agency Report DTRA01-03-D-0017 (Washington DC: DTRA October 2006), 7.
[4] Gray, *Out of the Wilderness*, 10.

exploration campaign, or the dependent variable, is the result. Once the nature is defined, key predictive characteristics of an exploration campaign become available for a strategist. Defining this dynamic requires an understanding of the two viewpoints that underlie the dichotomy of state exploration; the pragmatism of national security utility and the transcendence of idealism.

Pragmatist Model of Exploration for National Security

Whether through economic competition for access to spice trade markets or combating nuclear annihilation fears in modern times, the need to address urgent national security needs drives a state. From this standpoint, pragmatists' arguments for exploration base upon a realist interpretation of the writings of Thucydides; a Peloponnesian War era Greek general and the father of modern thought with respect to national security.

Thucydides described the whole of state action as resting upon the foundations of fear, interest, and honor.[5] In Thucydides' model, fear drives a state to preserve and protect its existing power against the menace of existential threats.[6] Interest is analogous to a state's relentless pursuit of economic benefit or political advantage as a means to enhance the reach of power beyond existing capabilities.[7] Honor is the measure of a state's relative prestige and ideological potency as understood by both its domestic citizenry and other international state

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[5] Robert B. Strassler, *The Landmark Thucydides* (New York: Free Press, 1996), 43.
[6] Strassler, *The Landmark Thucydides*. Although Thucydides never provides *explicit* detail about his precise definition of fear as a motivator of state relations, he repeatedly uses the word fear to describe the *implicit* atmosphere of extreme tension, distrust, and duress that drove military conflict between Athens and Sparta. The definition of fear used for this dissertation, i.e. protection from loss, is therefore the author's interpretation of Thucydides' intent.
[7] Strassler, *The Landmark Thucydides.* In his work on the Peloponnesian Wars, Thucydides uses the term "interest" to describe efforts by either Sparta or Athens to extend political power and grow regional influence against the enemy. Hence, from the author's perspective, rather than simply protecting states from the loss of existing power, interest seeks to aggrandize *more* power than what currently exists.

actors.[8] Taken together, these three factors synthesize to become a state's overall national security requirements. Well-protected, highly developed, and prestigious states enjoy more assurance of their national security needs than states deficient in these qualities. With such power, nations rise as recognized leaders on the world's stage, advance to the forefront of global influence, and are far less likely to succumb to rival state challenges to authority.

Thus, aggrandizing state power becomes the ultimate prize in the turbulent arena of *realpolitik-based* international relations.[9] In this sense, states should pursue exploration because of its pragmatic extrinsic value for pursuing national security. However, arguing state exploration efforts originate purely to serve this purpose denies the very real, if less tangible, benefits that accrue to societies engaged in exploration, such as enhancements to education, cultural richness, and societal inspiration.

Idealist Model of Exploration for Transcendence

Opposing this pragmatist standpoint are those who value exploration primarily for its intrinsic transcendent effects upon society. This view relates to idealist traditions and originates in the writings of such philosophical powerhouses as John Locke and Immanuel Kant. As described by Locke,

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[8] David Kagan, *The Peloponnesian War* (New York: Penguin Publishing, 2003), 46.
[9] Everett C. Dolman, *Astropolitik: Classical Geopolitics in the Space Age* (New York: Frank Cass Publishers, 2002), 156.

> He and the rest of all mankind are one Community, make up one society distinct from all other creatures. And were it not for the corruption and vitiousness of degenerate Men, there would be no need for any other; no necessity that Men should separate from this great and natural Community…[10]

Locke viewed humans as belonging to a common brotherhood that shared universal ideals designed to elevate states above the brutish pursuit of raw power. Man, in his view, was inherently good, sought knowledge as a means to elevate consciousness of the natural world, and valued liberty and universal equality above all other principles.[11] The best states in the world understood these standards, structured their governments appropriately, and acted to promote these ideals.[12]

From Kant's perspective, the quest for knowledge, as opposed to dogmatic mysticism, was a human imperative. In his work, *The Critique of Pure Reason*, he wrote,

> it must still remain a scandal to philosophy and to the general human reason to be obliged to assume, as an article of mere belief, the existence of things external to ourselves (from which, yet, we derive the whole material of cognition for the internal sense), and not to be able to oppose a satisfactory proof to anyone who may call it in question.[13]

Kant believed full knowledge of the natural world was attainable by humans and the act of pursuing this knowledge would lead to a better, more progressive society. Furthermore, Kant argued that governments of the type advocated by Locke could eventually form the basis of a pacific union of liberal nations in which state actions on the world stage

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[10] John Locke, "Second Treatise," in *Two Treaties of Government*, ed. Peter Laslett (New York: Cambridge University Press, 1988), para 128.
[11] Michael W. Doyle, *Ways of War and Peace* (New York: W.W. Norton & Company, 1997), 214.
[12] Doyle, *Ways of War and Peace*, 214.
[13] Immanual Kant, "The Critique of Pure Reason," trans. J.M.D. Meiklejohn, *Gutenberg E-Book*, http://www.gutenberg.org/files/4280/4280-h/4280-h.htm (Accessed 10 August 2012).

were designed to foster a condition of perpetual peace as opposed to the warlike "winner take all" competition inherent in the realist worldview interpretation of pragmatism.[14]

From this standpoint, the act of state exploration has inherent value unto itself; it is the free expression of the individual human spirit of curiosity and quest for adventure channeled through state action. States should be motivated to explore as a means to elevate and inspire the best qualities of humankind, enhance individual enlightenment, and transcend the human condition in ways previously unimagined. In this manner, the links that bond global society strengthen and the possibilities for peace enhance. However, while this view is inspirational, it does not take into account the harsh truths of how geo-strategic context affects a state's real actions regardless of the nobleness of its values.

The Patterns in the Noise

Both pragmatists and idealists assign definite value in the act of exploring frontiers, but differ as to what strategic ends exploration ultimately serves. Rather than being a point of division, however, the tension between these views serves as an excellent source to synthesize a model of the true dynamics motivating state exploration.

All state exploration campaigns feature a mix of idealist transcendence and national security pragmatism. Rarely, if ever, are states motivated to explore out of the absolute purity of one viewpoint vice the other. The act of exploring and taming a frontier appeals to both pragmatist and idealist dynamics. Given the necessary conditions, national security pragmatism becomes the initiating spark or sufficient condition of exploration while idealist principles create the flame to

[14] Doyle, *Ways of War and Peace*, 284.

build an enduring legacy and support long-term legitimacy. The significance of this insight is that these independent necessary and sufficient conditions, combined with an understanding of the geo-strategic dichotomy between pragmatism and idealism, produce simple, repeatable, and recognizable patterns that can help a strategist understand the nature of how state explorations initiate, sustain, and conclude. This nature of state exploration, or the dependent variable of this study, fits one of several pattern blueprints for understanding and predicting the natural characteristics of the resulting campaign. Analyzing the three major types of state exploration surveyed in chapter 1 provides insight into these patterns.

Motivations for Type 1 Exploration
[High National Security Pragmatism/Low Idealistic Transcendence]

In the fifteenth century, Portugal's King Manuel authorized Vasco De Gama's expedition as a final *coup de grâce* in opening a new spice trade route to India. This Portuguese crown authorized the act of naval exploration in hopes of transforming Portugal from a backwater nation into the nexus of European power. As per King Manuel's private letter to the Castile monarchy, De Gama's expedition was also a crucial step in defeating the Moors abroad by uniting the martial forces of Christendom under a single banner. Although the crown made sweeping overtures to the positive effect this would have upon humankind by saving souls and spreading the gospel of Christ, these appeals were in reality a thinly veiled excuse to destroy what remained of the Moors. In short, De Gama's mission was one of mercantilism, military conquest, and political power.

Since Moorish power in the Iberian Peninsula waned by the fifteenth century, the competitive threat posed to Portugal was non-existential in nature. Nonetheless, an exploration campaign against the Moors held important competitive risk value for the state because it

offered an opportunity to expand power. Through the lens of Thucydides, Portugal's motives for exploration based in the desire to address urgent national security concerns with respect to economic competition from the Moors. Caravels, compasses, Voltas, and intrepid explorers were the spears Portugal wanted to use to pierce the heart of Moorish power. While De Gama's voyage also served to increase knowledge, any idealistic notions of exploring the African coast and Indian Ocean for the pure sake of exploration or the transcendence of humankind were a distant second compared to the primary goal of enhancing national security. While initially successful, this style of pragmatic explorations to India became less and less fruitful as the Portuguese increasingly failed to update their strategy and modernize their fleet resources in the face of rising competition from the Dutch and British. Furthermore, the Portuguese failed to capitalize upon their newfound spice trade wealth to prevent invasion by the Spanish. In less than 100 years, Portuguese expeditions to India entered the realm of strategic overreach; a concept discussed in detail later in this chapter.

Fifteenth century Portugal is not the only state to turn towards exploration in hopes of addressing pragmatic national security issues. Additional sub-vignettes that provide corroborating evidence of this state behavior include:

A. **Polynesian Exploration of the Pacific.** Societies from locations as far removed across the Pacific Ocean as Indonesia, New Zealand, Hawaii, and Tahiti all share common genetics, related language structure, and similar cultural artifacts.[15] This linkage traces from a multi-generational, eastward migration begun by the Lapita; an ancient culture native to Southeast Asia.[16] Far from a happenstance occurrence, archaeological and historical

[15] Geoffrey Irwin, *The Prehistoric Exploration and Colonization of the Pacific* (New York: Cambridge University Press, 1992), 6.
[16] "Wayfinders: A Pacific Odyssey," *PBS*, http://www.pbs.org/wayfinders/ (Accessed 1 December 2012).

research indicates a deliberate act of Polynesian exploration. The prime motives behind this hazardous exploration across vast swaths of open ocean originate from several pragmatic national security-based dynamics; 1.) The power of the *Ali'i* (Chief) was politically derived from his ability to provide food and land to his tribe; 2.) Polynesian culture often branded contact with vanquished rival tribe members as *Kapu* (Spiritually Forbidden) and exiled them to find new islands; 3.) The need to prevent overpopulation and over-use of existing resources within the fragile ecosphere of an island; and 4.) A sea based trade economy whose relative geographic isolation encouraged the establishment of new markets.[17] Like Portugal, the Polynesians developed advanced ocean going ship technology, in the form of large multi-hulled canoes, and perfected the craft of "Wayfinding;" navigation over the open ocean without the use of compasses through the exploitation of ocean wave patterns and celestial observations.[18] In this manner, nearly three centuries before the first arrival of Europeans, the ancient Polynesians successfully explored over 800,000 square miles of ocean (nearly twice the size of the United States) and colonized islands as far removed as New Zealand, Easter Island, and Hawaii.[19] This pattern of exploration, however, was ultimately destroyed by the arrival of superior weapon technology, Christian evangelism, and devastating diseases carried by European explorers that wiped out large portions of the Polynesian civilization and severely disrupted the cultural norms of Polynesian society.

B. **Ferdinand Magellan's Circumnavigation of the Earth.** In June of 1494, the monarchies of both Spain and Portugal signed the Treaty of Tordesillas as a means to peacefully resolve a territorial dispute created by Christopher Columbus' inadvertent discovery of America while searching for a spice route to the Indies.[20] The treaty demarcated a longitudinal line along the middle of the Atlantic Ocean that ceded new territory east of the line to the Portuguese—essentially modern Brazil—while Spain would control newly discovered land to the west of the line.[21] This forced King

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[17] Irwin, *The Prehistoric Exploration*, 212-213.
[18] "Wayfinders," *PBS*, (Accessed 1 December 2012).
[19] "Wayfinders," *PBS*, (Accessed 1 December 2012).
[20] Stephen R. Bown, *1494: How a Family Feud in Medieval Spain Divided the World in Half* (New York: St Martin's Press, 2011), 6.
[21] Bown, *1494*, 6.

Charles I of Spain to seek a west bound route to the Indies and was the genesis of Ferdinand Magellan's harrowing voyage. Spain's national security goal, much like that of Portugal's trips to India, was to build and exploit economic wealth for advantage against state competitors, namely Portugal. Hence, the Moluccas, Indonesian islands rich in the rare and valuable spices of nutmeg and cloves, became a major object of Spain's naval conquest. Nutmeg and cloves, which sold for a higher price in the sixteenth century than their equivalent weights in gold, were thought to only exist on the Moluccas (also known as the Spice Islands) and were highly treasured because of their unique medicinal and food preservation qualities.[22] The location of the Spice Islands on the opposing line of longitude from the one demarcated by the Treaty of Tordesillas made their possession and exploitation be either Portugal or Spain a highly contested issue. Antonio Pigafetta, a scholar and explorer designated by Magellan to chronicle the voyage, captured the geo-strategic importance and contentiousness of the Moluccas when he wrote, "the King of Portugal had derived great profit from these islands and he took especial care to keep these countries concealed from and unknown to the Spaniards."[23] While Spain's exploration was successful in finding a westward route to the Moluccas, Magellan himself was killed in the voyage; losing his life on the Philippines during a battle in April of 1521.[24] In light of his death, overall attrition of the crew, and hazards encountered while rounding South America, the expedition elected to continue west as the safest route to return to Spain; risking hazardous travel through Portuguese controlled waters.[25] Therefore, while not originally intended, Magellan's expedition became the first to circumnavigate the Earth. Three gruelling years after departing Spain, the surviving remnants of Magellan's expedition limped into the port at Seville having lost a staggering four out of the original five ships and 242 out of 260 men.[26] Nonetheless, the remaining ship's cargo full of rare spices from Indonesia proved extraordinarily profitable. Ultimately, over the course of

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[22] Cynthia Gladen, "Cloves," *James Ford Bell Libraries - University of Minnesota*, https://www.lib.umn.edu/bell/tradeproducts/cloves, (Accessed 13 February 2013).
[23] Antonio Pigafetta, *The First Voyage Round the World by Magellan* (London: Halyky Society, 1884), 132.
[24] Pigafetta, *The First Voyage,* lx.
[25] Laurence Bergreen, *Over the Edge of the World: Magellan's Terrifying Circumnavigation of the World* (New York: Harper Collins Publishing, 2003), 364.
[26] Bergreen, *Over the Edge of the World,*13.

several follow on expeditions and multiple territorial clashes, Spain ceded its Moluccas island claims to Portugal in exchange for 350,000 gold ducats under the Treaty of Zaragoza; signed in 1529.[27] Today, Magellan's expedition is mainly remembered for its naming of the Pacific Ocean, discovery of the Straits of Magellan through the tip of South America, contributions to science, and heroic struggle against the elements. Its origins goals, however, were clearly designed to expand Spanish economic conquest.

C. **Captain Robert Fitzroy's Exploration of the South American Coastline.** In 1825, British Foreign Secretary George Canning signed an economic trade agreement with the recently independent federation of Argentinean states.[28] Establishing robust trade with these states, former colonies of Spain, offered Great Britain an emerging opportunity to seize influence in a geographically strategic region and build wealth at the expense of its Spanish rival. However, Great Britain lacked accurate hydrographic and land survey maps of the South American coastline; information crucial for ensuring safe navigation and the establishment of military outposts.[29] To address this gap in intelligence, the British Admiralty formally ordered Captain Robert Fitzroy on 15 November 1839 to take command of the *HMS Beagle* and, "proceed in her, with all convenient expedition, successively to Madeira or Teneriffe; the Cape de Verd Islands; Fernando Noronha; and the South American station."[30] To help provide intellectual stimulation during the expedition, Captain Fitzroy invited a young, unknown academic who was eager to join the expedition for the rare chance to study unique plant and animal life in South America. In Charles Darwin's words, the purpose of Britain's exploration was to, "complete the survey of Patagonia and Tierra Del Fuego, survey the shores of Chile, Peru, and some islands in the Pacific." However, the true value of the information returned from the expedition was the result of pure serendipity.[31] The voyage of the *HMS Beagle* would be forever remembered not

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[27] Bown, *1494,* 201.
[28] Pedro José Depetris "Charles Robert Darwin In Argentina's National Academy of Sciences" in *Revista de la Asociación Geológica Argentina*, 64 (Academia Nacional de Ciencias, 2009) 8.
[29] Depetris "Charles Robert Darwin," 8.
[30] Captain Robert Fitzroy, *Narrative of the Surveying Voyages of his Majesty's Ships Adventure and Beagle Vol 1.* (London: Henry Colburn, 1839), 22.
[31] Charles Darwin, *The Voyage of the Beagle* (University Park, PA: Pennsylvania State University, 2001), 6.

for its exploration advances in South American coastline hydrography, but for Darwin's side research of the Galapagos Islands and his formulation of the theory of evolution published in his 1859 work entitled *The Origin of Species*.[32] The voyage of the *Beagle* brought back troves of information that England used to establish important trading stations and military outposts, namely on the Falklands, to safeguard British interests in this region. Nonetheless, one of the most transcendent scientific discoveries of mankind, one that caused a paradigm shift in the study of biology and theology, owes its existence to a seemingly mundane exploration campaign commissioned with the intent to enhance British national security economic and military interests in the South America continent.

Motivations for Type 2 Exploration
[High National Security Pragmatism/High Idealistic Transcendence]

The early fifteenth century Ming dynasty expeditions of Admiral Zheng He were ambitious in scale even by the standards of a modern Navy. In a time nearly 100 years before Christopher Columbus, China sailed an armada of 300 ships led by *Bao Chuan* vessels larger than an American football field. This fleet, crewed by nearly 30,000 sailors, voyaged to destinations as far flung as East Africa. In the original Ming Dynasty dispatches and intentions of emperor Zhu Di, the original state motivations behind these epic voyages were twofold; 1.) Protect China from the immediate threats of financial ruin and foreign military invasion; and 2.) Spiritually redefine Chinese society from Confucian based agrarian isolationism to multicultural sophistication and global engagement. Within the geo-strategic context of the fifteenth century, both goals were synergistic, featured existential competitive risk, and thus carried a strong imperative for the future of China. Absent a blatantly grandiose outward display of strength to the world, the yoke of external powers and civil unrest would crush Zhu Di's rule and legacy.

[32] Depetris "Charles Robert Darwin," 9.

Without a shift in consciousness and ideas, Chinese society would never be ready to benefit from its newfound strength to become a great state capable of wondrous accomplishments for all of humankind. In essence, the emperor's goals for China featured strong influences from both pragmatism and idealism as well as high or existential competitive risk for the state. During the 22-year reign of the *Yongle* emperor, the seven voyages of China's fleet seemed well adapted to these goals. While expensive to execute, the expeditions returned precious artifacts, valuable financial tribute, and priceless knowledge to the Ming court while simultaneously exhibiting China's culture, ideology, and military strength to many parts of the world.

However, following the death of the *Yongle* emperor, the state's perception of exploration's impact upon society turned dramatically darker. The dramatic political and strategic cultural return to Confucian isolationism made the naval expeditions prime targets for immediate cancellation by the new Ming emperor. This radical shift in leadership instantly undercut the reason for state exploration. The new emperor viewed continued exploration on the scale of the *Bao Chuan* as too high a cost in relation to the state benefit achieved; another indication of strategic overreach. The new emperor ordered the destruction of state records concerning Zheng He voyages, authorized the burning of the fleet, and officially disavowed the positive impacts of the expeditions. This sudden retreat into the Middle Kingdom in the face of rising global competition set the stage for the continual erosion of China's economic, military, and cultural growth over the next 500 years. Consequently, whatever state resources the new emperor saved by the sudden cancelation of all exploration paled in comparison to the long-term losses endured by China during this decline. Interestingly, while deemed an abysmal failure by post-*Yongle* leadership in the fifteenth century, modern leadership touts these same voyages by Zheng He as a

crowning testament to the China's noble history, current national security territorial claims, and potential for international leadership in a globalized world. Hence, for the Chinese, the pragmatic and idealistic appeal of Zheng He's voyages continues to captivate. Similar explorations in history include:

A. **British Exploration of the Pacific**. During the eighteenth and nineteenth century Age of Enlightenment, many European nations embarked upon exploration campaigns as a tool to secure pragmatic national security concerns.[33] In an era characterized by revolutionary shifts in knowledge, nations capable of quick adaptation stood the best chance of gaining prestige and exploiting information for national military and economic advantage. However, as the Age of Enlightenment was also fundamentally a movement to transform notions of theology, government, and science, exploration during this time also served as a powerful vehicle to achieve idealistic principles of transcendence.[34] The three voyages of Captain James Cook to the Pacific from 1768-1779 best represent this synergy of pragmatic national security and the quest for idealistic transcendence.[35] As related by John Rickman, a historian aboard Captain Cook's third voyage, the expeditions were widely celebrated for ground-breaking astronomical observations of the transit of Venus across the sun, medical advances in the prevention of scurvy, and innovations in the field of navigation through the use of advance chronometers.[36] Captain Cook is also credited for his discovery and exploration of the Sandwich Islands (Hawaii), New Zealand, Australia, and his extensive research and documentation of cultures, plants, and animal life in every port of call visited over a decade of

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[33] Daniel Headrick, *When Information Came of Age: Technologies of Knowledge in the Age of Reason and Revolution 1700-1850* (New York: Oxford University Press, 2000), 8-9.

[34] Headrick, *When Information Came of Age, 8-9.*

[35] James Cook, *Captain Cook's Journal During His First Voyage Round The World Made in H.M. Bark "Endeavour" 1768-71*, ed. Captain W.J.L. Wharton (London, 1893).

[36] John Rickman, *Journal of Captain Cook's Last Voyage to the Pacific Ocean on Discovery* (London: E.Newberry, 1781), xxxiv-xlviii.

travel.[37] However, in addition to achieving these transcendent goals, Captain Cook's voyages were also aimed squarely at securing important British national security objectives, to include the conquest of new territory and exploitation of new resources. For instance, the British crown was extraordinarily fascinated in the potential discovery and conquest of *Terra Incognita Australis* (The Unknown Southern Land); a continent believed to exist since the age of Ptolemy that balanced out the land mass of continents discovered in Earth's northern hemisphere.[38] The mysterious continent held the allure of undiscovered wealth and power for the nation that claimed it first. In secret orders dated 30 July 1768, Cook was directed to explore the Southern Ocean in search of this continent and to keep classified all ship records, officer log books, and private journals until they could be reviewed by the British Admiralty.[39] As the likelihood of an unknown southern continent faded, Cook's exploration objectives were modified by the Admiralty to include the discovery of a Northwest Passage to help secure British commercial rights to lucrative natural resources along the Pacific Northwest.[40] In Great Britain, Cook's voyages and accomplishments are still tremendously inspirational to the populace and his tragic death in battle on the island of Hawaii during his third voyage only cemented his reputation as a national hero.[41] His contributions were so extraordinary to humankind that NASA named two out of the five American space shuttles, Endeavour and Discovery, after ships James Cook used in his exploration of the Pacific.[42]

B. **American Expedition of Lewis and Clark**. Under the Louisiana Purchase of 1803, the United States paid

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[37] Rickman, *Journal of Captain Cook's Last Voyage*, xxxiv-xlviii.
[38] Martin Dugard, *Farther than any Man: The Rise and fall of Captain Cook* (New York: Washington Square Press, 2001), 107.
[39] "Secret Instruction to Captain Cook 30 June 1768," *Museum of Australian Democracy*, foundingdocs.gov.au/resources/transcripts/nsw1_doc_1768.pdf (Accessed 11 November 2012).
[40] Dugard, *Farther than any Man*, 236.
[41] Rickman, *Journal of Captain Cook's Last Voyage*, 371.
[42] "NASA Orbiter Fleet," *NASA*, http://www.nasa.gov/centers/kennedy/shuttleoperations/orbiters/orbiters_toc.html (Accessed 1 December 2012).

the government of France $15 million to lay claim to 838,000 square miles of land west of the Mississippi river.[43] President Thomas Jefferson, long fascinated with the Western frontier and eager to protect the national security interests of the young United States, dispatched a secret message to Congress. Dated 18 January 1803, the memo urged Congress to appropriate $2,500 for an expedition to, "extend the external commerce of the United States" with Indian nations living within the territory the US was about to acquire.[44] The purpose was to help pacify the threat to US security from native tribes who have, "been growing more and more uneasy at the constant diminution of the territory they occupy."[45] This memo and the territorial purchase became the genesis of the famous frontier expedition of Army officers Meriwether Lewis and William Clark. In official orders dated 20 June 1803, President Jefferson defined the object of the Lewis and Clark expedition as the exploration of, "the Missouri river, & such principal stream of it as by its course and communication with the waters of the Pacific ocean whether the Columbia, Oregon, Colorado or any other river may offer the most direct & practicable water communication across this continent for the purposes of commerce."[46] Along the way, the explorers were to record extensive scientific data concerning the geography, weather, plant and animal life, and Indian cultures encountered in the newly acquired lands.[47] The epic transcontinental expedition, lasting from 1804 until 1806, has become a singular legend in American folklore; known for opening a route to the west, asserting American national security sovereignty over the Louisiana territory, energizing the quest for knowledge, and

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[43] Thomas Fleming, *The Louisiana Purchase* (Hoboken, NJ: John Wiley & Sons, 2003), 116.
[44] Thomas Jefferson, "Transcript: Jefferson's Secret Message to Congress," *Library of Congress*, http://www.loc.gov/exhibits/lewisandclark/images/lcp0001p1.jpg (Accessed 1 September 2012).
[45] Jefferson, "Transcript," (Accessed 1 September 2012).
[46] Thomas Jefferson, "Thomas Jefferson to Meriwether Lewis, June 20, 1803, Instructions," *Library of Congress*, http://www.loc.gov/exhibits/lewisandclark/transcript57.html (Accessed 1 September 2012).
[47] Jefferson, "Thomas Jefferson," (Accessed 1 September 2012).

inspiring the nation to voyage west in search of new beginnings.[48]

C. **The United States Exploring Expedition**. In August of 1838, six ships weighed anchor and left the port of Hampton Roads Virginia on a voyage of unprecedented scope for the fledgling US Navy.[49] In addition to the standard complement of naval officers and crew, the ships carried a broad mix of scientists from fields as diverse as mineralogy, horticulture, philosophy, and biology.[50] Their unique mission would take them on an extraordinary voyage of exploration around the world and was the culmination of years of wrangling within the US Congress concerning the future of the nation. As early as 1828, President John Quincy Adams argued for sending a US ship around the world for the purposes of demonstrating America's growing emergence as a world power.[51] However, it wasn't until the impassioned address to Congress in 1836 by Jeremiah Reynolds, influential newspaper editor and explorer, that the US government approved of not just one, but six ships for this purpose.[52] Reynolds skilfully mixed national security with America's role in transcendence when he spoke, "We mean a naval enterprise or voyage of discovery to be fitted out in the best manner with every scientific appliance at the public expense for the sole purpose of increasing our knowledge of the Pacific and Southern Oceans where our commerce is now carried on as we shall be able to show far beyond the bounds of ordinary protection."[53] Reynolds argued, and Congress appropriated funds, for a voyage designed to establish the US on the path to global scientific excellence while simultaneously protecting vulnerable and increasingly valuable commercial fishing areas and trade routes to China across the Pacific. The expedition would also serve the purpose of surveying the largely unknown shores of

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[48] "The Journals of the Lewis and Clark Expedition," *University of Nebraska*, http://lewisandclarkjournals.unl.edu/index.html (Accessed 15 July 2012).
[49] John Stillwell Jenkins, *Voyage of the US Exploring Squadron* (New York: Auburn, 1850), 28.
[50] John Stillwell Jenkins, *Voyage of the US Exploring Squadron*, 28.
[51] Jeremiah Reynolds, *Address on the subject of a surveying and exploring expedition to the Pacific Ocean and South Seas* (New York: Harper Publishers, 1836), 189.
[52] Reynolds, *Address,* 74.
[53] Reynolds, *Address,* 25.

> Antarctica.[54] The size of the expedition, much like Zheng He's expeditions, was designed to impress upon all nations who saw it the splendor and military might of the United States. In addition to satisfying these national security needs, the scientific bounty returned by the expedition in 1842 greatly accelerated the growth of the fledgling research community in the United States. The artifacts and data returned were so numerous and varied that they helped spawn the establishment of the Smithsonian Institution and became the bulk of the museum's initial collection.[55] The Exploring Expedition, coupled with the western land expeditions conducted by Army officer John Fremont, created a Golden Age of exploration between 1840 and 1860 in which the government allocated as much as quarter to a third of the federal budget to explorations of the ocean and land frontier.[56] However, the deepening divisions concerning slavery within America and the coming Civil War would eclipse this Golden Age of exploration.

Motivations for Type 3 Exploration
[Low National Security Pragmatism/High Idealistic Transcendence]

Conquest of the South Pole held little in terms of direct national security benefit for either Great Britain or Norway. No existential hostile rivalry existed between the two nations. The South Pole possessed no strategic choke points critical for seizing power from other states. The extreme environmental conditions and rugged geography of Antarctica meant that any discovered natural resources would be prohibitive for any nation to exploit. Over 100 years later, despite significant technological advances and Antarctic territorial claims by many states, the harsh challenges of the environment still pose near impassible

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[54] Reynolds, *Address, 255.*
[55] Nathaniel Philbrick, "The Scientific Legacy of the US Exploring Expedition," *Smithsonian Libraries*, http://www.sil.si.edu/digitalcollections/usexex/learn/Philbrick.htm (Accessed 5 October 2012).
[56] Philbrick, "The Scientific Legacy of the US Exploring Expedition," (Accessed 5 October 2012).

barriers to resource access. Furthermore, the frozen continent was devoid of any indigenous population; thereby removing any notion of bringing religious salvation or any other form of cultural exploitation to the populace. These factors made the perceived competitive risk to either state low or peripheral to other concerns given the geo-strategic context. Hence, unlike many previous campaigns throughout history, neither government committed massive support of state resources towards South Pole exploration. Despite these factors, the prize of reaching the only remaining location on Earth's surface unexplored by humans held a transcendent allure unto itself. As such, the governments of both states proffered crucial endorsements of these expeditions and provided at least partial funding. In essence, Scott and Amundsen were on journeys sparked by national security honor and interest to address primarily idealist principles. In addition to the exploration of Antarctica, one other significant example is:

A. **British Oceanographic Survey of the Ocean Basins.** By the mid to late 1800's, hydrographic surveys of the major continental shorelines of the world were complete. However, a dearth of knowledge existed concerning the great ocean depths. The prevailing wisdom of the time was that no life existed in the ocean at depths beyond 500 meters due to tremendous pressure, darkness, and cold temperatures.[57] As further described in letters by William Spry, a crewman aboard *HMS Challenger*, many scientists of the day believed, "the specific gravity of water at considerable depth would be so great that any heavy weight thrown into the sea must be arrested, and remain suspended forever."[58] However, cursory scientific expeditions performed by the British ships *Lightening*, *Porcupine*, and *Hassler* brought back initial

[57] "The History of Ocean Exploration," *The British Natural History Museum*, http://www.nhm.ac.uk/nature-online/science-of-natural-history/expeditions-collecting/hms-challenger-expedition/exploration-history/index.html (Accessed 15 September 2012).
[58] William J.J. Spry, *The Cruise of Her Majesty's Ship "Challenger",* 2nd edition (London: Sampson Low, Marlston, Searle & Rivington, 1877), 1.

evidence suggesting a significantly more diverse ocean biosphere and complex marine geography than had been previously suspected.[59] For the British naturalist community, the ocean depths promised an unparalleled boon of research to redefine scientific understanding of life on Earth. Despite the transcendent allure of a voyage to discover the ocean depths, the spark to initiate this exploration came from pragmatic state economic interests. The British government was interested in gaining an understanding of the deep sea floor for sake of laying the first trans-Atlantic telegraph cables. On 7 December 1871, the British government provided £200,000 for the expedition and commissioned the *HMS Challenger* to accomplish a multiyear circumnavigation of the world.[60] According to the official British Admiralty orders, *HMS Challenger's* expedition was designed to learn 1.) The Physical conditions of the deep sea throughout all the great Ocean-basins; 2.) The chemical constitution of the water at various depths from the surface to the bottom; 3.) The physical and chemical characters of the deposits; and 4.) The distribution of organic life throughout the areas explored.[61] By removing weaponry and converting spaces ordinarily used to carry canons and explosive powder into research laboratories, *HMS Challenger* became the world's first dedicated oceanographic research ship.[62] Under command by Captain Nares, *HMS Challenger* left Portsmouth on 21 December 1872 with a complement of 5 full time scientists under the leadership of Chief Scientist Wyville Thomson.[63] Over three years later, *HMS Challenger* and her crew returned to England having travelled nearly 70,000 miles and collecting enough data to produce 50 volumes and 29,552 pages of research that took over 19 years to fully analyse and

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[59] Sir C. Wyville Thomson, *Voyage of the HMS Challenger During the Years 1873-76*, (London: Majesty's Government, 1885), xlvii-xlix.
[60] "The History of Ocean Exploration," *The British Natural History Museum*, (Accessed 15 September 2012).
[61] Thomson, *Voyage of the HMS Challenger,* liii.
[62] "The History of Ocean Exploration," *The British Natural History Museum*, (Accessed 15 September 2012).
[63] Lord George Campbell, Log Letters from "The Challenger" (London: Macmillan & Co., 1876), 1.

publish.[64] By any account, it was one of the great scientific explorations of human history.

[64] "The History of Ocean Exploration," *The British Natural History Museum*, (Accessed 15 September 2012).

The Exploration Model

Figure 15 below summarizes the analysis of historic campaigns conducted for this research.

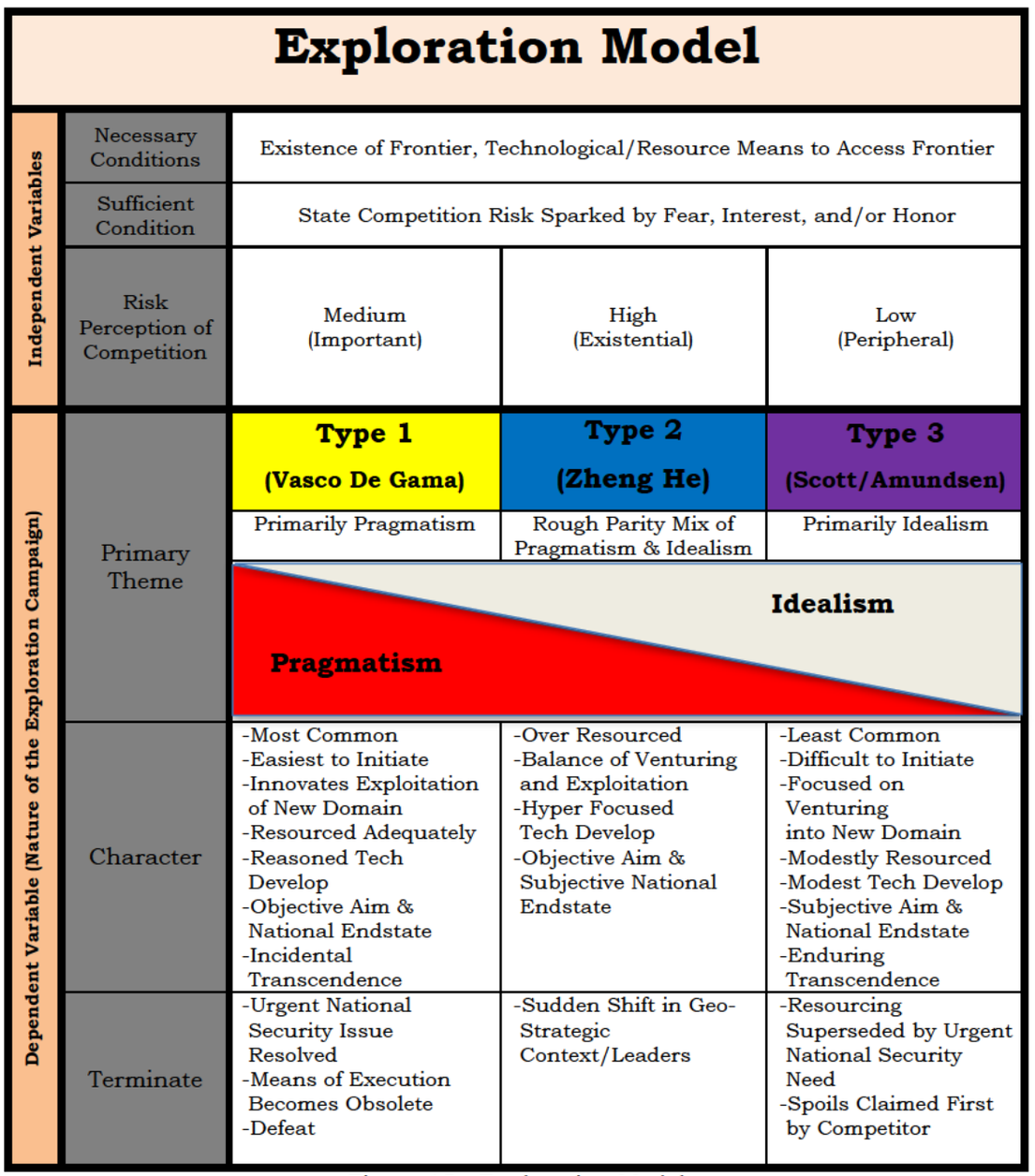

Figure 15: Exploration Model

This Exploration Model highlights several dynamics useful for a strategist. Chief among these insights is that while the forces surrounding pragmatist and idealist motives can be complicated, the brief survey and analysis of historic exploration indicate the two viewpoints combine in relatively simple patterns. Explorations characterize as originating in pragmatist thought, a rough equivalence of the two, or by idealistic views. The Exploration Model broadly designates these combinations as Type 1, 2, and 3 respectively. Given the necessary conditions, all explorations spark by the sufficiency condition of state competitive risk to at least one national security element of fear, honor, and/or interest. Assignment to a category, the dependent variable in state exploration, depends on analysis of the original source documentation motivations for state exploration, contextual understanding of the two independent variables (existence of a new frontier and the resources/technology to access the frontier), and an assessment of a state's perception of competitive risk based on its strategic culture. These type classifications delineate important attributes of an exploration campaign that have repeated throughout history regardless of era or state. As such, a strategist can reasonably expect these types of patterns to continue into the future.

Because of their design to address an important national security threat, Type 1 explorations are relatively easy for a state to justify for initiation and feature clearly defined objective campaign exploration goals and national endstates. For example, the Portuguese crown tasked Vasco De Gama to open a sea route to India as his exploration goal while the crown defined the national endstate as Portugal's economic control of the spice trade. States operating within this category assess exploration competition as moderate; the achievement exploration aims have impact upon important state issues, but not issues of high enough importance to rank as existential ones. For

instance, the Spanish crown supported Magellan's exploration for the Spice Islands to help expand Spain's economic advantage over Portugal. While important to the state, control of the Moluccas was not existential for Spain as indicated by the terms agreed to under the Treaty of Zaragoza. Type 1 campaigns tend to be the most common, focus on exploiting domains for advantage, and feature resourcing sufficient to accomplish their purpose. As evidence, the methodical hydrographic exploration campaigns of the British along South America and Prince Henry's build-up exploration campaigns along the Guinea coast of Africa are representative of this characteristic. This quality helps Type 1 explorations to feature reasonable technology development efforts, as evidenced by the Polynesian development of ocean going canoes and the craft of Wayfinding as well as the Portuguese advancement of the caravel and knowledge of the Voltas. While transcendent goals are present in Type 1 explorations, their achievement is incidental, serendipitous, or secondary to the primary national security aim. The original British pragmatic intentions for the voyage of the *Beagle* vice the idealistic accomplishments of its passenger Charles Darwin demonstrate this quality.

Type 2 explorations are similar to Type 1 except that they feature objectives that scope to encompass transcendence in addition to immediate utility. For instance, the *Yongle* emperor's designed intentions for the voyages of Zheng He were to prevent invasion from neighboring states as well as idealistically to transform Chinese society from isolationism to cosmopolitanism. Types 2s represent a sweet spot in exploration because the geo-strategic context they exist within grants high significance to the achievement of their pragmatist and idealist objectives. Captain Cook's epic explorations across the Pacific Ocean for both scientific and territorial conquest reasons highlight this characteristic. States that embark upon Type 2 explorations do so out

of a perception of a high competitive risk to achieving the spoils of exploration. The state considers these threats as vital or existential. The expedition of Lewis and Clark across the American interior benefited from this quality as evidenced by President Jefferson's impassioned pleas to Congress to assert immediate American sovereignty across the newly acquired Louisiana Purchase before other nations usurped and occupied territory of the United States. Type 2 explorations can feature hyper-focused technology development efforts and balance venturing into the unknown with innovative exploitation of the new domain. China's feverish development and epic voyages of the mammoth *Bao Chuan*, by far the grandest ships in the world for several centuries, represent these qualities. Because of their nature, Type 2s feature objective exploration campaign goals and subjective national endstates. For example, the US commissioned the United States Exploring Expedition with an objective campaign goal of asserting control over vulnerable ocean shipping routes to Asia. The US subjectively defined the national endstate of this expedition as inspiring international respect and enhancing American scientific prowess. Often, Type 2 explorations can feature an over-commit of resources due to the initial enthusiasm and inertia that these campaigns receive. As such, Type 2 explorations can be counterproductive to their own pragmatic origins as their execution costs can outweigh the initial return on investment. Clearly, the Ming dynasty leadership, following the death of the *Yongle* emperor, assessed this flaw with respect to Zheng He's expeditions.

Type 3 explorations are campaigns that feature predominantly idealist motivations. As they have relatively low appeal to national security utility, they are the most difficult for states to justify for initiation. Type 3 explorations initiate with subjective exploration goals and national endstates, such as increasing human knowledge or enhancing societal inspiration. These explorations focus almost

exclusively on venturing into the unknown and less on immediate exploitation of the new frontier. As such, states resource Type 3 explorations at significantly lower levels than Type 1 or Type 2 efforts. Nonetheless, their successful accomplishment garners a positive legacy for the state and contributes greatly to the store of humankind. The voyages of Scott and Amundsen across the Antarctic and the British scientific voyages of the research vessel *HMS Challenger* are textbook-like examples of these defining characteristics.

In addition to these attributes, the model also warns of the perils of state exploration. Embedded within each exploration type are the elements of the campaign's own demise. The patterns of state behavior in these classifications warn the strategist to the warning signs of termination and strategic overreach. Like the elements of national security, the concept of strategic overreach originates from Thucydidean based pragmatist thought. Understanding this dynamic is the last step in the construction and use of the Exploration Model.

Termination and the Dangers of Overreach

There exists a potential calamitous consequence for states acting in the extreme margins of the Exploration Model, particularly for Type 2 explorations. Exuberant idealist mania or the single-minded pursuit of pragmatist national security can blind states to the pitfalls of strategic overreach. Thucydides warns of this possibility in his history of the Peloponnesian Wars through his account of the ill-fated Sicily campaign.

In this vignette, Athens staked nearly the entirety of its military resources upon an invasion of Sicily, a territory loosely aligned with its enemy Sparta.[65] Through gross risk management of sunk versus opportunity costs, distorted patriotism, poor understanding of the geo-

[65] Strassler, *The Landmark Thucydides*, Book 6 and 7.

strategic environment, and dogmatic adherence to dimly defined goals, the Athenians suffered a grievous military loss on the island of Sicily.[66] The once-mighty Athenian navy lay sunken in ruins off Sicilian shores and large portions of Athens's army were obliterated. As stated by Thucydides,

> They were beaten at all points and altogether; all that they suffered was great; they were destroyed, as the saying is, with a total destruction, their fleet, their army-everything was destroyed, and few out of many returned home.[67]

Athens never recovered from such a loss; victory for Sparta during the Peloponnesian Wars became all but assured.

In similar fashion, a unique twist on strategic overreach befell the Greek King Pyrrhus during conflict against Rome over 100 years after the Peloponnesian Wars. King Pyrrhus achieved victory against Roman forces during the Battle in Asculum, but at such great cost to his own forces that it crippled his ability to prosecute further attacks against Rome.[68] King Pyrrhus summarized his predicament best when he stated, "If we are victorious in one more battle with the Romans, we shall be utterly ruined."[69] The term Pyrrhic victory, meaning a triumph achieved at a crippling cost far in excess of the benefits gained, derives from the experience of King Pyrrhus.

While strategic overreach derives from military conflict, the concept has direct application to state exploration. Just as in military conflict, recognizing when an exploration has reached the point of culmination and crossed over into overreach is subjective and difficult. As stated by noted strategist Colin Gray, states recognize the

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[66] Strassler, *The Landmark Thucydides*, Book 6 and 7.
[67] Strassler, *The Landmark Thucydides*, 478.
[68] Plutarch, "Life of Pyrrhus," in *The Parallel Lives*, ed. Loeb Classical Library Edition Vol IX (Cambridge, MA: Harvard University Press, 1920), 21:5.
[69] Plutarch, "Life of Pyrrhus," 21:8.

culmination point only, "after adverse consequences unmistakably tell you where it was."[70] Nonetheless, the brief survey of exploration history above indicates two major characteristics of impending overreach; 1.) Confusing the ways and means of exploration as the ends of exploration; and/or 2.) Rigid, uncritical execution of exploration campaigns irrespective of new geo-strategic contexts. This usually occurs when state resources have been committed to a campaign in such excess as to generate inertia inflexible to change.

For these reasons, Type 2 explorations are highly susceptible to strategic overreach. Their general attributes make them unsustainable in the long term, as was experienced by the Chinese during the expeditions of Zheng He. Type 1 explorations should terminate at the risk of crossing strategic overreach once their original national security objective is no longer exigent, the state is defeated in its exploration goals by an adversary, or the means to address the national security need becomes obsolete. Explorations continued beyond this point run the danger of losing justification and committing resources to fruitless causes. Such was the case for the Portuguese during the decline of their role in the spice trade in the later years of the Age of Discovery. Although far less likely than Type 2 or 1, Type 3 explorations should terminate when a competitor achieves the spoils of transcendence, or when states leverage resources for Type 3 exploration at the expense of more fundamental survival needs.

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[70] Colin Grey, "Why Strategy is Difficult," in *Foundations of Strategy* (Maxwell AFB, Alabama: Air University Press, 2011), 11-12.

Conclusions

The Exploration Model, developed by analyzing campaigns across half a millennia and states as diverse as China and the United States, will help strategist holistically understand state exploration efforts. It represents a synthesis of both pragmatic and idealistic themes, highlights the necessary and sufficient conditions to initiate exploration as independent variables, and predicts the nature of the resulting exploration campaign as the dependent variable. As a result, this model is a unique vantage point with which to view the previous 50 years of human spaceflight and predict the likelihood and potential future of human spaceflight exploration in US grand strategy.

Chapter 3

THE THIRST FOR FIRST

Exploration Model in the Early Human Space Race: 1903-1969

> *The exploration of space will go ahead, whether we join in it or not, and it is one of the great adventures of all time, and no nation which expects to be the leader of other nations can expect to stay behind in this race for space.*
>
> President John F. Kennedy, 1962

The pragmatist national security concepts of fear and honor served as the sufficient condition to spark the tumultuous early human space race between the Soviet Union and the United States. The unique geo-strategic context, one that suspended humankind's future in the balance between the ideologies of two rival superpowers, created the quintessential idealist conditions for a Type 2 class of exploration campaigns. Both sides viewed the competitive risk of failure as high or existential given the obvious pragmatic space technology ties between boosters used for human spaceflight and rockets necessary for nuclear weapons delivery. Because of these two dynamics, access to the emerging frontier of space would become the stage upon which to address urgent national security dynamics as well as desires to achieve transcendence on behalf of all humankind.

Each nation's conception of pragmatism and idealism were a reflection of specific strategic cultural beliefs. These beliefs had a profound impact upon each state's view of the interplay between technology, exploration of a new physical domain, and society. As a precursor to the space age, the development of aviation in the early twentieth century serves as a useful foreshadow of the underlying themes of the space race. Understanding the political and cultural

dynamics of human spaceflight and the insatiable thirst for first in the space race begins by first examining each state's approach to its early aviators and airplanes.

Daring Aviators & Machines, Death From Above, Utopian Bliss

On the sandy shores of North Carolina, humankind realized an age-old quest. From the fable of Daedalus and Icarus, to the experiments of Otto Lilienthal and Samuel Langley, humans have always dreamed of mastering flight.[71] Orville and Wilbur Wright, two remarkably innovative bicycle makers from Dayton Ohio, brought this dream to reality on 17 December 1903.[72] Preserved for all time in an iconic photograph, the flight of the 1903 Wright Flyer from the windswept hills of Kitty Hawk heralded the birth of the modern airplane.

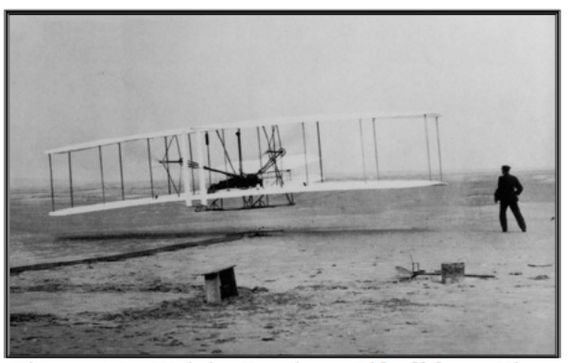

Figure 16: Wright Brothers Liftoff from Kitty Hawk

Source: http://oneclimbs.com/2010/09/05/the-pride-and-prosperity-cycle/ (Accessed 22 April 2011).

During the early twentieth century, nations around the world realized the potential of the airplane to serve as a potent economic instrument, military weapon, and effective means of transportation.[73] As such, the technology of the airplane had immediate pragmatic utility for solving national security concerns. However, as the ultimate technological symbol of humankind's knowledge and mastery over the natural world, the airplane also possessed transcendent qualities that

[71] Peter L. Jakab, *Visions of a Flying Machine* (Washington, DC: Smithsonian, 1990), 19-30.
[72] Jakab, *Visions of a Flying*, 209-211.
[73] Scott W. Palmer, *Dictatorship of the Air* (New York: Cambridge, 2006), 1.

fundamentally altered how societies measured the attainment of ideological ends. Within Russia, these distinctive views of the aircraft were especially compelling.

For imperialist Russia, the aircraft was a transcendent symbol of modernization. Czar Nicholas II, keenly self-conscious of his nation's international reputation for backwardness, sought the aircraft as a tool for Russia to, "assume its rightful place as the most cultured and advanced of European states."[74] Russian citizens eagerly joined flying clubs and flocked in the thousands to air shows. For them, the aircraft was a beacon of hope for a better life. By innovating foreign aircraft designs, Russia's fledgling air force became one of the largest in the world prior to World War I.[75] In addition, famed aviation designer Igor Sikorsky garnered international acclaim for Russia by producing the mammoth *Il'ya Muromets* bomber.[76] Named after a mythic Russian folklore hero, the *Il'ya Muromets* was unrivaled for many years in both size and performance as the world's first four-engine bomber.[77] Unfortunately, these exploits produced more for headline grabbing attention than substantive aviation development. The hollowness of the Russian approach to aviation was a key reason for its catastrophic defeat in World War

Figure 17: Propaganda Poster Extolling "Mighty" Soviet Aircraft

Source: "XPlanes," http://xplanes.tumblr.com/post/73458433, (Accessed 18 April 2011).

[74] Palmer, *Dictatorship of the Air*, 282.
[75] Palmer, *Dictatorship of the Air*, 66.
[76] Palmer, *Dictatorship of the Air*, 63.
[77] Palmer, *Dictatorship of the Air*, 282.

I.[78] Nonetheless, while the Bolshevik Revolution of 1917 ended the rule of the Romanov Czars, it did not extinguish Russia's infatuation with the mystique of the airplane.

Whereas imperial Russia sought parity with the West, communist Russia under the rule of Premier Joseph Stalin sought total domination.[79] Within this new Soviet worldview, the aircraft was a critical component in establishing a Marxist utopia. State directed modernization for aircraft production would transform Russia from a backwards, agrarian society into a powerhouse of industrial might. Mandatory participation in state sponsored aviation societies would force a culture of air-minded citizens willing to sacrifice all to achieve the modernity that aviation promised. The communist party leadership lionized Soviet aviators as heroic symbols of self-sacrifice, loyalty, and collectivity. The Soviets derided private entrepreneurship, creativity, and economically driven innovation as tools of class oppression.[80]

For a brief period in the 1930s, Soviet aviation experienced extraordinary gains in terms of production and capability.[81] However, the abject poverty, distrust, fear, and widespread brutality spread by Premier Joseph Stalin's purges were increasingly at odds with the promise of modernity through aviation. Towards the end of the 1930s, the Soviet aviation industry wallowed in gross inefficiencies and was becoming increasingly reliant on the West for innovation and support.[82] Stalin hid these truths from domestic and international society by staging widely publicized record-breaking flights as proof of Soviet aviation superiority.[83] Unfortunately, like his Czarist predecessor,

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[78] Palmer, *Dictatorship of the Air*, 74.
[79] Palmer, *Dictatorship of the Air*, 286.
[80] Walter A. McDougall, *The Heavens and the Earth* (Baltimore, MD: John Hopkins, 1985), 72.
[81] Palmer, *Dictatorship of the Air*, 195-196.
[82] Palmer, *Dictatorship of the Air*, 249.
[83] Palmer, *Dictatorship of the Air*, 233.

Stalin's increasing attention to image over substance would be the downfall of Russian aviation. In the opening years of Operation Barbarossa, Hitler's well equipped and operationally proficient *Luftwaffe* (Air Force) shamed Soviet air power.[84] Hence, this pattern of technological idolatry, intense fear, irrational Idealist beliefs, and bold face bluffing to preserve national honor formed the patterns of Russian thought with respect to the significance of flight. Russian aviation historian Scott Palmer termed this pattern as compensatory symbolism.[85] Palmer's concept is a critical component to understanding the Soviet Union's approach to exploration through emerging aerospace technology.

As with Russia, aviation development in the United States unfurled as a reflection of unique societal characteristics. While the significance of the Wright brothers' invention blossomed quickly in Europe, aviation was slower to catch on in America. Europeans developed technologies to explore the air domain from a Type 1 exploration standpoint; the close proximity of enemy nations drove countries to innovate the aircraft as a weapon of national security. For the United States, the geo-strategic protection afforded by the Atlantic and Pacific oceans drove US officials to view the airplane as a simple curiosity with limited utility. American explorations of the air domain were representative of Type 3 state behavior. As a result, the US Army possessed only eight aircraft at the start of World War I.[86] In contrast, Russia possessed 190 airplanes.[87] After America's 1917-1918 involvement in World War I, however, the airplane became a fixture of the American military and society. Like the Russians, the wonders of aviation fascinated Americans. However, the ethos of the American

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[84] Palmer, *Dictatorship of the Air*, 259.
[85] Palmer, *Dictatorship of the Air*, 282.
[86] Lee Kennett, *The First Air War: 1914-1918* (New York: Free Press, 1991), 21.
[87] Kennett, *The First Air War,* 21.

World War I fighter pilot, the heroic knight of the air, coupled with cultural values of freedom and openness, shaped America's approach to flight very differently from that of the Russians.

Fundamentally, US citizens did not bestow aviation with the transcendent power to shift society from misery to utopia. Instead, Americans viewed aviation as a tool for individual progress, financial gain, and adventurous challenge.[88] As military budgets shrank in the post-World War I environment, the US returned to a Type 3 exploration standpoint and private enterprise assumed the mantle for aviation development.[89] Rather than state controlled development, intense commercial rivalry between such companies as Curtiss, Vought, and Boeing fueled developments in aircraft performance and flying qualities. American aircraft, pilots, and mechanical crews were a constant presence at international aviation competitions such as the Schneider Cup and Bleriot races.[90] World War I veteran pilots used their skills to foster cultural air-mindedness by becoming barnstormers, opening flight schools, or serving as pilots in the budding airline and airmail industries. US aviation heroes, such as Charles Lindberg, James Doolittle, and Amelia Earhart, were championed for their independence and daring spirit, not for loyalty or collective sacrifice.

Figure 18: James Doolittle Symbolized the American Aviator Individualist Ethos

Source: "Racers: Jimmy Doolittle and the Perfect Curtis R3C-2 Seaplane," *Airpigz*, http://airpigz com/blog/2010/7/9/coolpix-racers-jimmy-doolittle-and-the-perfect-curtiss-r3c-2.html (Accessed 23 April 2011).

[88] Palmer, *Dictatorship of the Air*, 282.
[89] McDougall, *...Heavens and the Earth*, 76.
[90] "Barnstormers and Racers," *Century of Flight*. http://www.century-of-flight.net/Aviation%20history/daredevils/Schneider.htm (Accessed 10 February 2011).

These characteristics of American aviation spawned tremendous advances across the spectrum of aircraft technology. However, by the early 1940s, this free-hand approach to aviation development was quickly becoming inadequate to meet the immediate challenges of wartime production.[91] Within the context of World War II, tighter government oversight of aviation and directed technological innovation became the keys to support Allied victory.

The American approach to aviation, with its focus on individual spirit, commercial innovation, and minimal government oversight, was in stark contrast to the Soviet approach. Both approaches to aviation had their pros and cons. Soviet style centralized control and execution maximized short-term advancement towards solving a problem, but stifled innovation and encouraged inefficiency. Using this approach, Soviet aviation industry experienced tremendous gains in the early 1930s, but quickly decayed to bureaucratic slough, bluffing, and obsolescence by 1940. America's *laissez-faire* (leave to do) approach fostered tremendous creativity, but hindered organized effort towards a defined immediate goal. These paradigms were deeply entrenched within the Soviet and American cultures. These patterns of thought and experiences during aviation's Golden Age from the 1920s to the 1930s undergirded both Soviet and American approaches to the exploration of space in the coming years.

[91] McDougall, *...Heavens and the Earth*, 79.

Early Space Age Exploration

As the embers of World War II smoldered, a mad dash was under way between the Soviet Union and the United States to acquire talent and material from the German rocketry program. Technologies developed during World War II, such as the computer, ballistic missile, and nuclear explosives, enabled a new class of global warfare unprecedented in human history. Each side deeply dreaded the implications to national security if its nemesis outpaced it technologically. Both had pre-war rocketry aspirations. The Soviets, inspired by the cosmic futuristic visions of astronautical scientist Konstantin Tsiolkovsky, sought to develop a new class of rocketry weapons.[92] In similar fashion, the work of Professor Robert H. Goddard in the United States portended a new age of powerful liquid fueled rockets and space travel.[93] After the war, both nations viewed the V1 and V2 rocket successes of Dr. Werner von Braun's team at Peenemünde as the gateway to achieving their own strategic goals.

Figure 19: Dr. Werner Von Braun, Father of the American Space Program

Source: NASA Marshall Space Flight Center, "Von Braun and Walt Disney," *NASA*, http://history.msfc nasa.gov/vonbraun/disney_article.html (Accessed 24 April 2011).

At the conclusion of World War II, with both the Soviet and the American forces rapidly closing in on German rocket facilities, Dr. Braun willingly surrendered to Allied forces to avoid capture by the Soviets.[94] Intelligence officials debriefed Braun and transferred him to the United States where he eventually became the technological mastermind behind the American rocket program. In the Soviet Union,

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[92] McDougall, *...Heavens and the Earth*, 19.
[93] McDougall, *...Heavens and the Earth*, 76-77.
[94] William E. Burrows, *This New Ocean* (New York: Random House, 1999), 116.

Sergei Korolev, a brilliant aerospace engineer imprisoned by Stalin during World War II, consolidated the remaining elements of the German missile program and became the Chief Designer of Soviet rocketry.[95] With the chessboard for the space race set, established cultural norms and idealistic values evident from the Golden Age of aviation shaped each country's approach to the new space age.

The Soviet Union continued its dogmatic adherence to state controlled innovation. Known as the technocratic approach, this style hinged on the belief that the function of the state should be, "transformed from one of political rule over men into a scientific administration of things and a direction of processes of production under scientific management."[96] Following the death of Stalin, however, Premier Nikita Khrushchev assumed power and began a new era of de-Stalinization.[97] Khrushchev promised a return to Leninist style communism and an emergence from the dark days of Stalin's rule. Similar to how his predecessors viewed the airplane, Khrushchev saw the rocket as both a pragmatic and idealistic technological means with which to transform Soviet society and the rest of the world into a utopia, garner honor, and instill fear in his American enemy.

Figure 20: Sergei Korolev, the Soviet Union's Chief Designer

Source: "Space Hall of Fame," *New Mexico Space Museum*, http://www.nmspacemuseum.org/halloffame/images.php?id=15 (Accessed 26 April 2011).

[95] James Schefter, *The Race* (New York: Doublesday, 1999), 9.
[96] Frederick Engels, "Socialism: Utopian and Scientific", *Marxists*, http://www.marxists.org/archive/marx/works/1880/soc-utop/ch01.htm (Accessed 20 January 2011).
[97] McDougall, *...Heavens and the Earth*, 56.

Khrushchev, while brash and sometimes erratic, was a master showman who understood the power of propaganda to accomplish state goals. While he did not understand rockets, he understood the political, military, and psychological significance of being the first nation to conquer the new high ground of space.[98] In his view, space leadership would unite the Soviet populace behind a common cause of national pride, remove the shackles of backwardness still haunting the Soviet psyche, and threaten the West with rockets capable of delivering nuclear payloads. In essence, space exploration in the Soviet Union represented Type 2 state behavior. Space exploration would become the ultimate means to address both Soviet views of pragmatism and idealism. The Soviet Union's technocratic approach to aerospace allowed Khrushchev significant leeway in allocating resources to Korolev's rocket program. This unified effort behind rocketry allowed Soviet scientists to announce intentions to launch a satellite within two years of the 1955 International Geophysical Year conference in Denmark.[99] The space race had officially begun, but few in the United States were paying attention.

Within the United States, post war rocketry efforts fractured between the military programs of the US Air Force and Army, and the civilian scientific research programs of the Naval Research Laboratory (NRL). Of all the various design efforts, the US Army's Jupiter program, under the direction of Dr. Braun, was the most advanced due to its projected use as America's first Intercontinental Ballistic Missile (ICBM).[100] Unlike the US Air Forces' Thor missile or the NRL's Vanguard atmospheric sounding rocket, Jupiter possessed the ability to

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[98] Burrows, *The New Ocean*, 180.
[99] John Hillaby, "Soviet Planning Early Satellite," *New York Times*, 3 August 1955, http://select.nytimes.com/gst/abstract.html?res=F5091FFC385C177B93C1A91783D85F418585F9 (Accessed 15 January 2011).
[100] Schefter, *The Race*, 15.

accelerate small payloads to orbital velocity as early as 1955.[101] However, the notion of using a military rocket for space exploration posed a quandary for the administration of President Dwight Eisenhower.

Eisenhower was extremely aware of the hair-trigger dangers of nuclear Armageddon in the early days of the Cold War. As such, he was wary of any effort that hinted at the militarization of space.[102] The Soviet Union could view non-scientific payloads launched from atop a military Jupiter missile as an act of aggression. Furthermore, the Russians could interpret US satellite over flights as serious violations of sovereignty. Eisenhower was also reluctant to shape the US government as a technocratic state.[103] He viewed the scientific exploration of space as something better left for civilian researchers. From Eisenhower's perspective, space exploration for the United States was a Type 3 state effort with greater applicability to research than to national security.

Within the context of Eisenhower's fiscally conservative New Look agenda, military rocket programs served only to establish a credible deterrent threat to Soviet capabilities. As explained by historian Walter McDougall, "It was not imperative that the United States be the first to do this or that, only that it be prepared to deploy missiles in equal or greater numbers at a higher level of guidance, survivability, and reliability."[104] Because of these policies, the civilian Vanguard program languished, and the military Jupiter rocket curtailed to serve strategic deterrence purposes only.[105]

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[101] Schefter, *The Race*, 18.
[102] Pat Norris, *Spies in the Sky: Surveillance Satellites in War and Peace* (Chichester, UK: Praxis Publishing, 2008), 9.
[103] McDougall, *…Heavens and the Earth*, 397.
[104] McDougall, *…Heavens and the Earth*, 133.
[105] Schefter, *The Race*, 16.

This split between military and civil rocketry was deeply rooted in US cultural norms valuing a *laissez-faire* approach to technology development. The utility of either the Soviet technocratic approach or the US hands-off approach to the space race would come to a significant turning point in October of 1957.

The Long Shadow of Sputnik

The cover page headline of the *New York Times* on 5 October 1957 captured the gravity of the moment poignantly; "Soviet Fires Earth Satellite Into Space; It Is Circling The Globe at 18,000 MPH; Sphere Tracked In 4 Global Crossings Over US."[106] True to their announced intentions in 1955, Korolev's rocket team launched *Sputnik* (Fellow Traveler) from Baikonur on 4 October 1957.[107] Boosted into orbit by a modified Soviet R-7 ICBM, *Sputnik* orbited the Earth for three months and was visible from the ground with the naked eye.[108] The Soviets deliberately designed its radio transmitter to broadcast a continuous string of beeps in the shortwave frequency band so that amateur radio hobbyist would be able to track its position across the globe.[109] The Soviets followed up one month later with the successful launch of *Sputnik 2*. This significantly more advanced satellite, weighing in at 1,120 pounds, carried Earth's first living space traveler; a mongrel

Figure 21: Laika, the World's First Space Traveler

Source: "Dogs in Space," *Space Online Today*, http://www.spacetoday.org/Astronauts/Animals/Dogs.html (Accessed 14 May 2011).

[106] William J. Jorden, "Soviet Fires Earth Satellite Into Space," *New York Times*, 5 October 1957, http://www.nytimes.com/partners/aol/special/sputnik/sput-01.html (Accessed 15 January 2011).
[107] Paul Dickson, *Sputnik: The Shock of the Century* (New York: Walker & Company, 2001), 9.
[108] Dickson, *Sputnik*, 17-27.
[109] Schefter, *The Race*, 16.

dog named *Laika* (Barker).[110] *Laika* survived on orbit long enough to prove that life was sustainable in a weightless environment.[111] The Soviets were clearly interested in human space travel.

Edward R. Murrow, veteran CBS reporter, captured the world's stunned reaction to *Sputnik* when he said, "We failed to recognize that a totalitarian state can establish its priorities, define its objectives, allocate its money, deny its people automobiles, television sets and all kinds of comforting gadgets in order to achieve a national goal."[112] The US attempted to counter the Soviet successes with a live TV broadcast of the launch of NRL's Vanguard rocket. At liftoff, the Vanguard rocket rose approximately four feet off the launch pad before exploding and collapsing back into a roiling cloud of rocket fuel and debris.[113] Dubbed "Flopnik" or "Kaputnik" by the press, the Vanguard failure only highlighted the extraordinary technical accomplishment of the Soviets and publically embarrassed an already humiliated United States. In desperation, Eisenhower finally authorized the use of the military Jupiter missile for

Figure 22: America's Flopnik

Source: *US Navy & NASA*, http://www.accessscience.com/overflow.aspx?searchStr=Rocket&stype=10&p=2 (Accessed 11 May 2011)

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[110] Schefter, *The Race*, 24.
[111] Chernov, V. N., and V. I. Yakovlev, *Scientific research during the flight of an animal in an artificial earth satellite*, Artif. Earth Satell., No. 1, 80-94, 1958; and differing accounts exist as to how *Laika* died. The Soviets never planned to return *Sputnik* 2 to Earth. Hence, *Laika's* fate was sealed the moment the rocket launched from the pad. However, some accounts state that *Laika* survived for a few hours upon reaching orbit and then died of heat exhaustion due to her "excited" state and a malfunction in the environmental system. Others state that she survived for several days and then died from a "merciful" lethal injection administered remotely from ground control. Either way, the author prefers not to add to the speculation and instead to simply recognize *Laika's* brief, but significant, contribution to human spaceflight.
[112] Burrows, *This New Ocean*, 190.
[113] Burrows, *This New Ocean*, 204.

orbital spaceflight. Using the Jupiter rocket, Dr. Braun's team was able to delivered Explorer I, America's first satellite, to orbit on 31 January 1958.[114]

Unfortunately, the damage to American honor and ideals were extensive and fears of Soviet domination intensified within the US. Soviet rocket successes deeply challenged Eisenhower's faith in the viability of a non-technocratic society. Internationally, America's reputation as the most advanced and progressive nation on Earth was tarnished.[115] Domestically, Eisenhower faced non-stop onslaughts from powerful education and science lobbies demanding action.[116] Democratic Presidential nominee John Kennedy excoriated Eisenhower's Republican administration for its slow reaction to Soviet rocketry advances and looming missile gap.[117] Premier Khrushchev, aware of the geo-strategic reverberations caused by the *Sputnik* successes, touted the Soviet political system as superior to the West and flaunted the potency of Russia's rockets to deliver a nuclear payload at will.[118] Eisenhower's only silver lining was that *Sputnik's* mission forever settled the legality of satellite flights over sovereign nations. Using *Sputnik* as a precedent, Eisenhower secretly green lighted military efforts to develop and operate spy satellites under the CORONA program.[119]

Shortly after *Sputnik*, the United States passed the Space Act of 1958. This act authorized the formation of the National Aeronautics and Space Administration (NASA) and charged the agency with the

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[114] Paul Dickson, *Sputnik: The Launch of the Space Race* (Toronto, CA: MacFarlane Walter & Ross, 2001), 190.
[115] Burrows, *The New Ocean*, 141-148.
[116] Burrows, *The New Ocean*, 141-148.
[117] Schefter, *The Race*, 46.
[118] Burrows, *The New Ocean*, 194.
[119] McDougall, *…Heavens and the Earth*, 134.

purpose of peaceful space exploration.[120] Peaceful or not, NASA's mission was a centerpiece in the global ideological struggle between democracy and communism. The United States finally viewed space exploration in the same light as the Soviets; a Type 2 state effort that required the full effort of America in order to satisfy both pragmatist and idealist principles. As such, the human space programs of both the United States and the Soviet Union accentuated the characteristics of their respective societies and highlighted human spaceflight's role in grand strategy under the geo-strategic context of the 1960s.

Celestial Knights and their Mighty Steeds

Like the heroic aviators and flying machines of the Golden Age of aviation, each state's space travelers and spacecraft were symbols of its respective idealist values and reflected each state's view of pragmatic national security fear and honor as a catalyst for exploration. In America, virtually every astronaut for the Mercury, Gemini, and Apollo programs was a professionally trained test pilot well familiar with the dangers of operating high performance airplanes in experimental situations.[121] Not until the final astronaut selection for the Apollo program did NASA allow a small cadre of civilian candidates from other career fields. Many of the 1960's era astronauts were combat veterans of the Korean War; several had shot

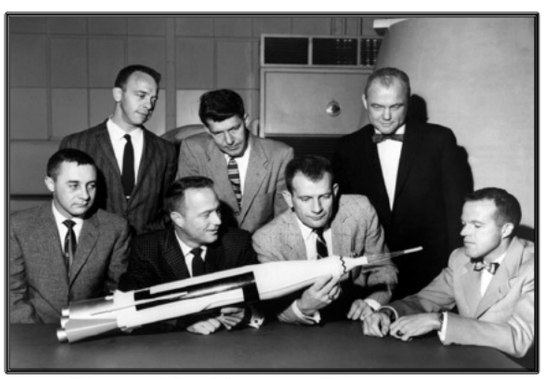

Figure 23: Mercury 7 Astronauts

Source: *NASA Langley*, http://vintagespace.wordpress com/2010/12/07/designing-the-perfect-astronaut/ (Accessed 22 April 2011).

[120] National Aeronautics and Space Administration, *Space Act of 1958*, Pub. L. No. 85-568 72 Stat. 426-438, 29 July1958, 16.
[121] Schefter, *The Race*, 52.

down enemy MiG fighter jets. All held engineering, scientific, or mathematical Bachelor degrees with several holding advanced Masters or Doctorate qualifications. Each devoted a significant portion of their official duties to participate in widely celebrated public affairs spectacles on behalf of America. In particular, each of the original Mercury 7 astronauts split a $500,000 contract from *Life* magazine in order to showcase the image of an idyllic American family.[122] *Life* magazine offered similar contracts to the Gemini and Apollo selection groups, although these later generation agreements were not as generous or lucrative.

Because of their test backgrounds and advanced education, astronauts were integral to the design of the Mercury, Gemini, and Apollo spacecraft. Each spacecraft featured redundant flight control systems and avionics similar to contemporary fighter aircraft. Later generations of Gemini and Apollo spacecraft not only featured the ability to shift orientation of the spacecraft, but also the ability to change orbit and use onboard radar to dock with other vehicles.

Hence, the United States selected its astronauts to serve as symbols of self-confidence, courage, and wholesome American family values; concepts of American ideals important for both the domestic and international audience. The American cultural values of freedom and openness meant that each astronaut's mission was broadcast real-time to the public. As a result, success or failure during these missions became a subject of intense international drama. Because of these characteristics, America presented, live to the world, the heroic image of free men using their individual talents and abilities to conquer the high ground of space using awe-inspiring and dangerous machines.

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[122] Schefter, *The Race*, 108.

In contrast, the Soviets adopted a much different approach to the design of their human spaceflight program. Korolev placed tremendous emphasis on a cosmonaut's ability to perform programmed tasks and rely upon automation. Early in the selection process he stipulated, "As has been repeatedly demonstrated in our automated flights and those with animals on board, our technology is such that we do not require, as the American Mercury project does, that our early cosmonauts be highly skilled engineers."[123] As the cosmonauts were essentially medical test subjects, selection criteria heavily favored candidates with unblemished health records and professional athlete-like physical fitness. While strict medical standards were also a characteristic of the US astronaut selection program, the Soviets exalted this quality above all other factors.[124]

Figure 24: Sergei Korolev, two trainers to his left, sits surrounded by the original six cosmonauts

Source: James Oberg, "Space Propaganda," *Wired Magazine*, 12 April 2011, http://www.wired.com/wiredscience/2011/04/soviet-space-propaganda?pid=1181&viewall=true (Accessed 14 April 2011).

The group of six original cosmonauts selected from the Soviet Air Force, known secretly in the Soviet Union as the *Vanguard or Sochi Six*, was politically loyal to the communist party and had demonstrated records of obedience to superiors. They were young and relatively untried compared to their American counterparts. Five out of the six were in their mid-twenties, none were test pilots, and only two possessed college degrees.[125] All of the six came from frontline Soviet Air Force fighter units, but only one

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[123] Yevgeni Karpov, "Beginnings," in Viktor Mitroshenkov, *Pioneers of Space* (Moscow: ProgressPublishers, 1989), 18.
[124] Schefter, *The Race*, 107.
[125] "At the Request of the Readers:Detachment of Air Force's Cosmonauts" (English title), Auiatsiya *ikosmonautika* no 5 (May 1990): 46-47.

flew a high performance fighter aircraft (MiG-19).[126] The most experienced pilot in the *Vanguard Six* had only 900 flight hours.[127] Yuri Gagarin himself possessed only 230 flight hours, roughly equivalent to the flight experience of a brand new fighter pilot in an American fighter squadron.[128] Space historian Asif Siddiqi summed up this difference between the qualifications of astronauts and cosmonauts when he wrote, "there was simply no requirement [among the Soviets] for significant piloting experience or skill at that point. The candidates had to be intelligent, comfortable with high-stress situations, and most of all physically fit."[129]

The Soviet government heavily sequestered all cosmonaut personal and professional lives from the public. Operational security protocols were so strict that each cosmonaut adopted a covert personal codename to use while flying space missions. Yuri Gagarin's personal codename during his *Vostok 1* mission was *Kedyar* (Cedar), while Valentina Tereshkova's was *Cheka* (Seagull) during *Vostok VI*[130] As a result, unlike their US counterparts, the Soviet government lionized cosmonauts as heroes only *after* a successful flight, never before. For instance, while the identities of Yuri Gagarin, Valentina Tereshkova, and Gherman Titov were state secrets before their missions, all three became international goodwill ambassadors of communism in the immediate aftermath of their spaceflights.[131]

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[126] Yaroslav Golovanov, "Koroleu Fakty," Rex Hall, "Soviet Air Force Cosmonauts." in Michael Cassutt. ed., Who's Who in *Space The International Space* Year *Edition* (New York: Macmillan, 1993), 210.
[127] Golovanov, "Koroleu Fakty," 210.
[128] Golovanov, "Koroleu Fakty," 210.
[129] Asif A. Siddiqi, *Challenge to Apollo: The Soviet Union and the Space Race 1945-1974,* NASA SP-2000-4408, 247.
[130] "Valentina Tereshkova", *Encyclopedia of World Biography*, http://www.notablebiographies.com/St-Tr/Tereshkova-Valentina.html (Accessed on 10 February 2011).
[131] Michael Sheehan, *The International Politics of Space* (New York: Routledge, 2007), 57.

The *Vostok* and *Voshkod* series of spacecraft were essentially spherical capsules with a small observation window. The cosmonauts sealed inside had almost no ability to control their spacecraft. Rather, ground stations controlled most spacecraft operations with the remaining systems functioning via full automation. During the *Vostok* and *Voshkod* program, Korolev expressly forbade cosmonaut design inputs, believing that engineers and scientists were better suited for spacecraft design than pilots were.[132] He viewed a cosmonaut's chief duty as performing medical experiments designed to chronicle the human body's reaction to weightlessness.

The only spacecraft controls available to the cosmonaut were a series of switches that manually activated the retrofire engines.[133] These controls were for emergency use only. However, to prevent a cosmonaut from individually using the retrofire engines to alter the planned descent and possibly defect to the West, the switches were protected by a six-digit cipher lock.[134] The first three digits of the combination flew with the cosmonaut in a sealed envelope. Mission control guarded the remaining three digits. As a further indicator of the

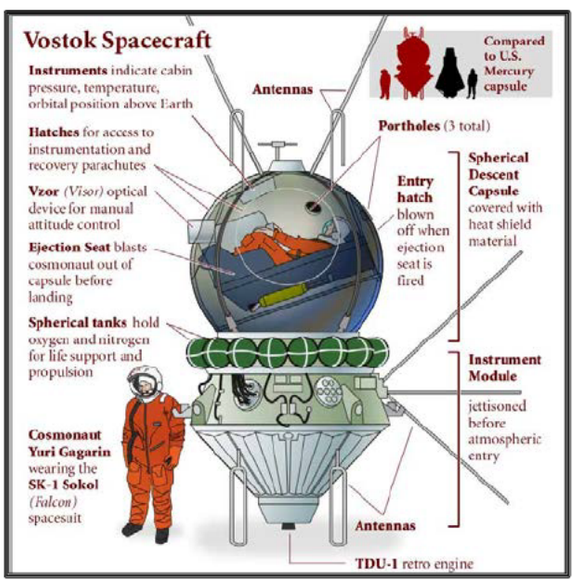

Figure 25: Vostok Capsule Diagram

Source: Asif Siddiqi, James Harford, and Dr. Wayne R. Matson, "Vostok Spacecraft," http://spaceresearchby.webs.com/apps/photos/photo?photoid=76224258 (Accessed 22 April 2011).

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[132] Yevgeni Karpov, "Beginnings," in Viktor Mitroshenkov, *Pioneers o] Space* (Moscow: ProgressPublishers, 1989), 18.
[133] Schefter, *The Race*, 108.
[134] Schefter, *The Race*, 108.

distrust inherent within the realities of Soviet life, each *Vostok* capsule was fitted with a secret compartment of explosives unbeknownst to the cosmonaut. In the event that a *Vostok* capsule was in danger of de-orbiting into enemy territory, mission controls could destroy *Vostok* remotely.[135]

Finally, normal recovery operations dictated that cosmonauts eject from the capsule at 20,000 feet.[136] Although the *Vostok* capsule itself used a recovery parachute, remaining with the capsule during ground impact was potentially fatal. The Soviets hid this secret capsule design for many years, as its discovery would have invalidated many *Fédération Aéronautique Internationale* (International Aeronautical Federation) records won by the Soviet human spaceflight program.[137]

These aspects of the Soviet cosmonaut program were in stark contrast to the American approach. Unlike the United States, the Soviet space program operated behind a dark veil of secrecy. The Soviets banned the live broadcast of any space mission to orchestrate an illusion of infallibility. Korolev's insistence on minimal cosmonaut control of the spacecraft emphasized Soviet faith in the ascendance of technology over the limitations of humans.[138] As such, the Soviet approach to human spaceflight echoed many of the aspects of compensatory symbolism evident during the Golden Age of aviation. The Soviet government trumpeted successful missions to the world as glorious proof of communist superiority. The Soviet's officially disavowed failures and accidents; some were classified state secrets. The most famous of which was the 1961 mishap involving cosmonaut Valentin Bondarenko.

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[135] Schefter, *The Race*, 108.
[136] Schefter, *The Race*, 136.
[137] Schefter, *The Race*, 136.
[138] Yevgeni Karpov, "Beginnings," in Viktor Mitroshenkov, *Pioneers o] Space* (Moscow: ProgressPublishers, 1989), 18.

Tragically, cosmonaut Bondarenko burned to death during a pressure chamber test when he accidentally discarded a cleaning cotton swab soaked in alcohol onto an electrical hot plate.[139] In an accident eerily similar to the Apollo 1 catastrophe six years later, the heated cotton swab ignited the pure oxygen atmosphere of the chamber and created an intense inferno that immediately over pressurized the chamber preventing rescuers from opening the hatch in time.[140] Bondarenko suffered excruciating third degree burns over his entire body and died eight hours later.[141] The Soviets obscured and denied this accident from the West for the next 25 years.[142]

Hence, both the American and Soviet designed their human spaceflight programs as reflections of their individual societies and as loudspeakers for how each state intended space exploration's role in grand strategy. As such, they became specially crafted tools of statecraft during the 1960s.

Geo-Strategic Context of the Early Space Age

The Soviets upstaged the United States not only with the launch of *Sputnik*, but also with the subsequent launches of the first person, Yuri Gagarin, first woman, Valentina Tereshkova, the first orbit of two crewed spacecraft simultaneously, and the orbit of three cosmonauts in a single capsule.[143] The Soviets seemed to be on a technological tidal wave of success that hobbled the West at every turn. Khrushchev used Tereshkova's flight in particular to highlight the difference between Soviet and Western society. As stated by Soviet space engineer Yu Zaitsev, "Once more the genuine equality between men and women in the USSR was made evident to the whole world; the courage, intelligence

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[139] James Oberg, *Uncovering Soviet Disasters* (New York: Random House, 1988), 159.
[140] Oberg, *Uncovering Soviet Disasters*, 160.
[141] Oberg, *Uncovering Soviet Disasters*, 160.
[142] Oberg, *Uncovering Soviet Disasters*, 159.
[143] Schefter, *The Race*, 181.

and skill of Soviet men and women, liberated from the shameful yoke of capitalistic 'civilization' was made evident."[144] Tereshkova's flight was particularly embarrassing to the United States; a nation featuring an all-male astronaut corps and a society mired in vicious racial violence.

This apparent Soviet supremacy in space gave Khrushchev special advantage in East Germany following the flight of cosmonaut Gherman Titov. Upon the landing of Titov's *Vostok 2* mission, Khrushchev approved the construction of the Berlin wall in Germany.[145] The West, humbled by Soviet technical rocketry advances and fearful of nuclear retaliation, was virtually powerless to address Soviet action.

In the United States, shortly after President Kennedy assumed office, the failed CIA plot to invade Cuba at the Bay of Pigs further tarnished America. Not long thereafter, Gagarin's successful flight trumped America's efforts to launch the first human into orbit. Khrushchev's efforts to construct the Berlin wall only served as another source of deep frustration. President Kennedy, initially a serious skeptic of the value of space exploration, started to realize the growing significance of the space program upon both idealist and pragmatist principles given the geo-strategic context of the 1960s. Addressing a joint session of Congress in 1961 following the flights of Yuri Gagarin and Al Shepard, President Kennedy encapsulated this insight when he spoke,

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[144] Yu I. Zaitsev, *From Sputnik to Space Station* (Yorks, UK: British Library, 1974), 57.
[145] Shefter, *The Race*, 149.

> If we are to win the battle that is now going on around the world between freedom and tyranny, the dramatic achievements in space which occurred in recent weeks should have made clear to us all, as did the *Sputnik* in 1957, the impact of this adventure on the minds of men everywhere, who are attempting to make a determination of which road they should take.[146]

Acutely embarrassed by a string of political failures early in his presidency, Kennedy decided to use the space program for grand strategic leverage.

By setting the moon as a space program goal, Kennedy sought to change the space race equation. Developing technology to reach the moon would require the Soviets and Sergei Korolev to retool and slow the pace of the Russian space program. This in turn would mitigate the political effects of Soviet space successes. Furthermore, flights to the moon would require tremendous technological innovation and a focused effort from industry. As such, Kennedy could use the space program as a means to marshal a technocratic style, socially supported organization able to counteract the Soviet program. For Kennedy, the moon was a deliberately difficult target to achieve and the most visible affirmation of the ideological dynamics of the Cold War.[147] As a pragmatic politician knowledgeable about Soviet compensatory symbolism, he also knew that a moon race was a challenge the Soviets were ill suited to win, but simultaneously unable to willfully cede to the Americans. To their detriment, it was a race the Soviets had to run. Kennedy, knowing this crucial aspect of US/Soviet geo-strategy, added this element of American destiny to this same speech before Congress when he spoke,

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[146] John F. Kennedy, "Address Before Joint Session of Congress, 25 May 1961," *John F. Kennedy Presidential Library and Museum,* http://www.jfklibrary.org/Asset-Viewer/xzw1gaeeTES6khED14P1Iw.aspx (Accessed 14 October 2012).
[147] Burrows, *The New Ocean,* 323.

> But this is not merely a race. Space is open to us now; and our eagerness to share its meaning is not governed by the efforts of others. We go into space because whatever mankind must undertake, free men must fully share.[148]

Before Congress on that day, President Kennedy publically endorsed American style Type 2 human space exploration. The nature of the American efforts in the space race reflected this purpose.

By the conclusion of the Mercury program, the United States had achieved parity with many of the Soviet space accomplishments. During project Gemini, Mercury's successor program, the United States surged well into the lead. Beyond 1965, the substantive space technological build-up approach used by the United States proved superior to the Soviet stunt-flight approach. While cosmonaut Alexei Leonov was the first to perform a spacewalk, the Americans were the first to perfect the technique.[149] While the Soviets were the first to orbit two spacecraft simultaneously, Gemini was the first to perform a rendezvous and docking.[150] At a pace of one rocket launch every two months, each Gemini mission improved upon the technological accomplishments of the previous mission. It was a pace of operations that Korolev's capsules and boosters were unable to match.

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[148] Kennedy, "Address Before Joint Session of Congress, 25 May 1961," (Accessed 14 October 2012).
[149] Nicholas L. Johnson, *Handbook of Soviet Manned Space Flight: Volume 48*, (San Diego, CA: Univelt Publishing, 1980), 79-82.
[150] Johnson, *Handbook of Soviet Manned Space Flight*, 45-49.

In 1964, Sergei Korolev suddenly died from complications during routine surgery.[151] Korolev's death threw the Soviet program into tremendous disarray. Many within the Soviet space program knew the race to the moon was lost as well as any associated political advantage gained by attempts to best the Americans. In the late 1960s, the Soviet space program fractured between efforts to build space stations and efforts to continue the appearance of a robust moon program.[152] This bifurcation of resources proved the death knell for the Soviets. Neither program gained sufficient technical or engineering traction. The catastrophic and expensive failures of the Soviet's colossal N1 moon rocket program, the counterpoise to the gargantuan American Saturn V, sealed the Soviet human spaceflight program's fate.[153] The race to the moon was over.

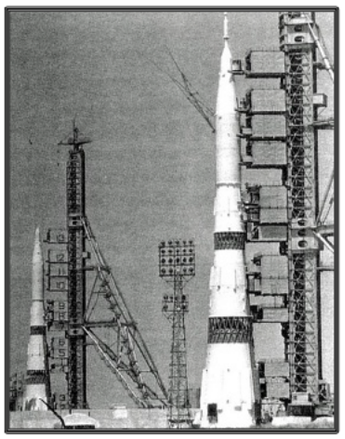

Figure 26: Failed Soviet N1 Booster

Source: Russian SpaceAgency, http://www.federalspace.ru/

The US was not immune to its own tragedies, the most notable of which was the February 1967 Apollo 1 launchpad fire that killed astronauts Gus Grissom, Ed White, and Roger Chaffee and grounded US human spaceflight for over a year and a half.[154] Nonetheless, the Americans resumed the moon race with a string of spectacular successes. Apollo 7 proved the human spaceflight viability of the Apollo capsule while Apollo 8 captured the world's attention as the first human circumlunar mission.[155] Apollo 9 was a successful test flight of the

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[151] Schefter, *The Race*, 231.
[152] "Manned Lunar Program," http://www.russianspaceweb.com/spacecraft_manned_lunar.html, Russian Space Web (Accessed 14 April 2011).
[153] Schefter, *The Race*, 282.
[154] "Apollo," *NASA*, http://www.nasa.gov/mission_pages/apollo/missions/index.html (Accessed 23 April 2011).
[155] "Apollo," *NASA*, (Accessed 23 April 2011).

Lunar Excursion Module in Earth orbit and Apollo 10 was a full dress rehearsal mission for the moon landing.[156] By the time Neil Armstrong and Buzz Aldrin set foot upon the moon's Sea of Tranquility on 20 July 1969, America's global honor and technological prowess in relation to the Soviets was undisputed.[157]

Figure 28: Astronaut Buzz Aldrin on the Moon

Source: *NASA*, http://spaceplace.nasa.gov/gallery-technology/

The impact to idealist principles was astoundingly monumental. President Richard Nixon captured this enduring legacy when he commented, "This is the greatest week in the history of the world since creation, because as a result of what happened in this week, the world is bigger, infinitely"[158] Collectively, the flights to the moon continue to be spotlighted as the highest achievement of humankind and a source of remarkable transcendent inspiration. For example, the awe-inspiring images of Earthrise, first witnessed by astronauts aboard Apollo 8, spawned a movement of global environmentalism, sponsored notions of a borderless world, and fostered the idea of citizens of the world living together aboard "Spaceship Earth." The impact to pragmatist national security fears, however, was far murkier than originally intended.

Figure 27: Earthrise from Apollo 8

Source: NASA, "Image of the Day," http://www.nasa.gov/multimedia/imagegallery/image_feature_102.html

The world of 1969 was dramatically different from the world of 1960. The charismatic energy, vision, and leadership of President

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[156] "Apollo," *NASA*, (Accessed 23 April 2011).
[157] Burrows, *The New Ocean*, 425-432.
[158] Richard Nixon, "Quotation Book," http://quotationsbook.com/quote/27245/ (Accessed 1 October 2012).

Kennedy were lost to an assassin's bullet in 1963.[159] Kennedy's spacepower nemesis, Premier Khrushchev, was removed from office by communist party elites following Khrushchev's dismal performance during the Cuban Missile Crisis. Premier Leonid Brezhnev replaced Khrushchev and directed Russian efforts more towards nuclear militarization efforts rather than headline grabbing space stunts. President Lyndon Johnson's domestic social focus during his Great Society program and President Richard Nixon's increasing involvement in Vietnam meant less focus on the dynamics of the space race. As evidence, NASA's budget as a percentage of gross domestic product, shrank from its 1966 high of 4.41% to 2.31% by 1969.[160] Adjusted for inflation, this loss is the year 2010 equivalent of a programmatic budget reduction of nearly $10.7 billion in three years.[161] From the public opinion standpoint, landing men on the moon had tremendous emotional significance, but fell far short of the pragmatist promise of defeating communism through extolling the virtues of freedom and democracy. Civil strife still dominated US domestic concerns, vicious wars still raged in far off lands, and the specter of nuclear doomsday still held the world captive despite the spectacularly successful Apollo program.

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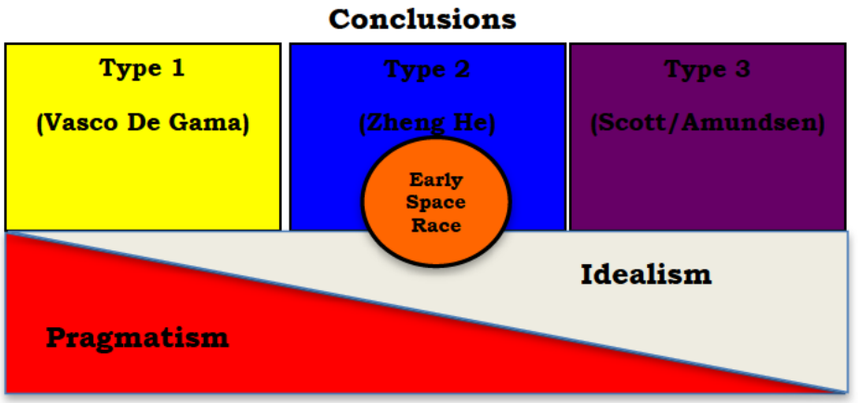
[159] McDougall, *...Heavens and the Earth*, 396.
[160] "NASA Budget History," *Office of Management and Budget and Augustine Commission Report*, 9 May 2000, http://www.rain.org/~bmuniz/Space/nasa_budget_history_total_budget.pdf (Accessed 11 March 2011).
[161] "NASA Budget History," *Office of Management and* (Accessed 11 March 2011).



The characteristics of the early space race between the Soviet Union and the United States was endemic of Type 2 exploration. The strident cultural appeals to idealist principles through the space program, coupled with the need to address pragmatist existential national security issues, created the geo-strategic environment for an audacious human spaceflight exploration campaign. Much like the Ming Chinese *Bao Chuan* fleet of the 15th century, both the Soviet Union and the United States embarked on a frantic technology development program, allocated outsized portions of their resources to the effort, and used exploration to showcase the best of their cultures. Like the *Bao Chuan* fleet, neither effort from the Soviet Union or the United States was sustainable in the long term due to tremendous expense, overspecialization of technology, and a changing geo-strategic context. In this sense, the United States experienced the modern day equivalent of a Pyrrhic victory; strategic overreach caused by success. With respect to human spaceflight, the recent experience of Type 2 exploration campaign brings contemporary context to several important lessons.

First, when a human spaceflight exploration sparks from the Thucydides' concept of fear and honor, the campaign will become a portrait reflection of sacred cultural values and a bullhorn to announce strength to the world. From the early era of aviation to the heady days

of the space race, the need to address fear and honor caused ideology to permeate all levels of aerospace development; from the iconic status of aviators and space travelers, to the types of programs pursued, and the minute technical details of aircraft and spacecraft engineering design. In particular, honor will cause a heavy emphasis on the achievement of technological superlatives as a demonstration of state superiority. Building the largest or fastest aircraft, being the first to fly a human in space, or being the first to land on the moon are all prime examples of the thirst for first motivated by the quest for honor. Fear will cause states to tout honor achievements as surrogate demonstrations of military superiority. However, the saga of aviation and human spaceflight in Russia offers a cautionary tale for when this quest distorts into compensatory symbolism at the expense of substantive technological achievement.

Second, any short-term gains made from Type 2 human spaceflight explorations are extremely subjective and entirely dependent upon the overarching international relations and domestic context. For example, despite impressive accomplishments, gains from human spaceflight in the 1960s were not able to save America's space program from staggering financial cuts and massive losses in political clout during the 1970s. Furthermore, despite the hopes of state leaders, ideological triumph in space had little correlation to ideological supremacy on Earth.

Last, despite the ultimate minimal impact to national security needs, both nations revere their efforts in the early space race for its enduring idealist legacy to human transcendence, science, and knowledge. Few can deny the inspirational aspect to the achievements of this era; from the flight of Gagarin to the last footsteps on the moon during Apollo 17. For better or for worse, the idealist principles addressed during this timeframe forever embedded in humankind's

consciousness the colloquialism, “If we could put a man on the moon, why can’t we…”

With the close of the early space race, geo-strategic dynamics during the 1960s and 1970s offered another class of exploration for human spaceflight. Rather than a hyperbolic Type 2 exploration trajectory, the Cold War entered an era increasingly marked by the use of human spaceflight for Type 1 explorations. Rather than venturing deeper in to the unknown, human spaceflight shifted to investigating innovative means to exploit the new domain of space to address pragmatist based national security fears.

Chapter 4

DOVE OF PEACE AND HOUND OF WAR

Exploration Model in Military Human Spaceflight: 1950-1990

Within the next 10 or 15 years, the earth will have a new companion in the skies, a man-made satellite that could be either the greatest force for peace ever devised, or one of the most terrible weapons of war -- depending on who makes and controls it.

Dr. Werner von Braun, *Collier Magazine*, 1952

In 1952, Dr. Werner Von Braun wrote a series of articles for *Collier* magazine detailing a futuristic version of spaceflight. In one article entitled *Crossing the Last Frontier*, Dr. Braun described his concept of an orbiting military battle station.[162] Nuclear armed, serviced by futuristic looking spaceplanes, and occupied by a crew of up to 50 astronauts, Von Braun's fanciful but dark vision of space captivated the attention of the world to the military uses of human spaceflight technology.[163]

By the mid 1960's, this concept began to cross the realm from fantasy to reality. By the close of the early space race, both the United States and the Soviet Union turned more and more of their attention from the notion of Type 2 space explorations to Type1; innovating exploitation of space as a practical tool for national security. The pragmatics of national security fear was still a major catalyst to shape human spaceflight exploration. However, as the frontier of space became more and more understood, the initial hysteria fears of the early

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[162]Roger D. Lanius, *Space Stations: Base Camps to the Stars*, (Washington, DC: Smithsonian, 2003), 27-35.
[163] Lanius, *Space Stations*, 27-35.

space race had stabilized and coalesced into a more reasoned concern for how best to use the domain of space for military advantage. In the Exploration Model, competitive risk shifted from existential to important. In this regard, human spaceflight technology filled a niche as a dove of peace and a hound of war. One of the primary technical means with which to fulfill pragmatist national security fear originated at Austria's University of Vienna at the dawn of World War II.[164]

Jousting Spaceplanes of the High Frontier

In the mid-1930s, rocketry expert Dr. Eugene Sanger and his mathematician wife Dr. Irene Brendt began studies into an exo-atmospheric, hypersonic, crewed vehicle capable of reaching and bombing targets on the other side of the globe.[165] The craft was a futuristic wonder weapon; featuring a behemoth takeoff weight of 110 tons and a special two mile long horizontal rail launch system that would accelerate the vehicle to takeoff speeds in excess of 1,100 mph.[166] The *Luftwaffe* studied the concept under their World War II *Amerika* Bomber program, but ultimately decided it posed too many technical challenges given Germany's limited resources and wartime realties.[167] However, plans for the Sanger-Brendt Antipodal Bomber became an engineering means

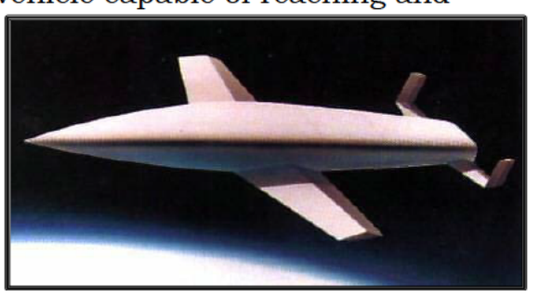

Figure 29: Sanger-Brendt Antipodal Bomber Concept

Source: MBB, "Saenger," http://www.astronautix.com/lvs/saenger.htm, (Accessed 25 April 2011)

[164] Robert Godwin, *Dyna-Soar: Hypersonic Strategic Weapon System* (Ontario, CA: Collector's Guide Publishing, 2003), 7.
[165] Bart Hendrickx and Bert Vis, *Energiya-Buran* (Chichester, UK: Praxis Publishing, 2007), 13.
[166] *History of the X-20A Dyna-Soar. Volume 1* (USAF Systems Command, Aeronautical Systems Division. Technical Report ASD-TR, 1983) 3.
[167] Godwin, *Dyna-Soar*, 7.

with which to satisfy deep-seated national security issues within both America and the Soviet Union.[168]

Within the United States, the spotlight on the prestige garnering Mercury, Gemini, and Apollo space programs masked an ever-growing Department of Defense push in the late 1950s and 1960s to exploit human spaceflight exploration for strategic military advantage. In this era, the specter of nuclear doomsday held the world hostage to the palpable fear of instant global annihilation. The power to hold these fears at bay, through an impressive nuclear deterrent capability, became the showcase military mission of the early Cold War.[169] Hence, the embryonic United States Air Force, ever mindful of the need to justify its existence within the Department of Defense, began to envision human spaceflight as a tantalizing way to expand global reach to the high frontier. Senior Air Force leaders foretold of an era in which the military person's role in spaceflight would be indispensable to addressing national security fear. General Bernard Schriever, commander of Air Force Systems Command, summarized this sentiment best in a 1961 paper he authored entitled *Manned Operational Capability in Space*.

> More emphasis on manned spacecraft is required. We must develop the ability to use space on a routine, day-to-day basis. In order to develop this ability we must begin by developing the ability to place large payloads in space, the ability to navigate and maneuver spacecraft, the ability to go into space and return to earth at times and places chosen to support a selected mission, the ability to rendezvous in space and accomplish refueling or cargo transfer; in short, to transport, use, and support man in space.[170]

From this perspective, advances in technology blurred the distinctions between the air and space domain such that orbital flight

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[168] Hendrickx and Vis, *Energiya-Buran*, 13.
[169] Jeffrey G. Barlow, *Revolt of the Admirals* (Washington, DC: Ross and Perry, 2001), 293.
[170] Bernard Schriever, *Manned Operational Capability in Space*, November 1961.

would be the natural extension of atmospheric flight. In similar fashion to the ascendancy of jet airplanes over propeller driven aircraft, spacecraft would eventually assume the same missions as their conventional atmospheric counterparts, albeit at much higher speeds and altitudes. Inherent in this desire for military human spaceflight exploration was steadfast faith, in the face of tremendous advances in automation and ballistic missile technology, of a human's utility to aerospace combat. General Curtis LeMay, then the Vice Chief of Staff of the Air Force, championed this view when he stated, "The most reliable guidance system we have is man. Should a more reliable and lighter weight system be developed, it will still lack judgment…and judgment is essential in war."[171] Within this context was the genesis of a state-of-the-art crewed spaceplane designed to best the Soviets in a strategic war.

In September of 1962, amidst a lavish Las Vegas convention center gala, the United States Air Force officially unveiled Dyna-Soar; a sleek, delta shaped, black, hypersonic gliding spaceplane designed to place the Soviet Union on notice concerning US spacepower capabilities.[172] Sharing the stage that day with the futuristic spaceplane was General Schriever along with six specially recruited initial cadre test pilots; five were from the Air Force and one

Figure 30: Dyna-Soar Spaceplane

Source: Steve Weintz, "Dyna-Soar: The Air Force s Manned Spaceplane of 1960," *USAF*, http://www.warisboring.com/2010/07/10/dyna-soar-the-air-forces-manned-spaceplane-of-1960/ , 10 October 2010 (Accessed 28 April 2011).

[171] Curtis E. LeMay, "Future of Manned Bombers," *Ordnance Magazine*, September-October, 1958, 205.
[172] Apogee Books, *Las Vegas Rollout*, Dyna-Soar Movies, 11 min., 2003, DVD.

was a retired Navy test pilot currently flying for NASA.[173] Using the legacy work of the vaunted X-15 program, Dyna-Soar was envisioned as a single seat, multi-role, combat spaceplane that would skip along the outer reaches of Earth's atmosphere while performing its reconnaissance, anti-satellite, or orbital bombardment mission.[174] At mission completion, Dyna-Soar would then glide to a conventional runway landing at a friendly airbase where personnel would service the vehicle in preparation for another mission.[175] Rather than being air launched like its X-15 cousin, Dyna-Soar would rocket to operational speeds and altitudes at the tip of a heavily modified Titan booster. Plans for the program called for three distinct development stages.

Dyna-Soar I was a conceptual research vehicle designed to achieve speeds of 12,000 mph in a ballistic trajectory reaching an apogee of up to 350,000 feet.[176] Dyna-Soar II would be the first militarily operational platform, with a range over 5,000 nautical miles at altitudes of up to 170,000 feet and speeds similar to Dyna-Soar I.[177] Dyna-Soar III, the final version of the spaceplane, would carry a thermonuclear weapon and achieve orbital velocities and global ranges at altitudes up to

Figure 31: Capt. Ed Dwight, One of the Original USAF Test Pilots Recruited for the Dyna-Soar Program

Source: UPI , "For the Sheer Love of It," *Aviation News*, http://www.aviation-news.co uk/archive/Mach%2025.html

[173] Apogee Books, *Las Vegas Rollout*, 2003, DVD.
[174] Apogee Books, *This is Dyna-Soar*, Dyna-Soar Movies, 13 min., 2003, DVD.
[175] Apogee Books, *This is Dyna-Soar*, DVD.[175]
[176] Godwin, *Dyna-Soar*, 42.
[177] Godwin, *Dyna-Soar*, 44.

300,000 feet[178]. By skimming the Earth's atmosphere at similar speeds to an Intercontinental Ballistic Missile (ICBM), but at much lower altitudes, Dyna-Soar proponents touted a reduction in the Soviet's window of early warning from 15 minutes to 2 minutes.[179] Yet, even these blistering speeds were not enough to escape the gravity well of US political and economic constraints of the 1960s.

Dyna-Soar's extinction began in early 1962. Early in the program, Congress signified its earnestness for the Dyna-Soar project by voting to fund the program with $158.8 million dollars, fully $85.8 million dollars more than the original request from President Kennedy.[180] However, Secretary of Defense Robert McNamara perceived Dyna-Soar as too expensive in light of the moon race against the Soviets. Several months prior to the roll out ceremony, McNamara signaled his desire to shift Dyna-Soar from an operational spaceplane to a research vehicle like its X-15 predecessor.[181] McNamara capped this decision by mandating a name change from Dyna-Soar to X-20. Development work on the spaceplane continued throughout 1963, however lack of a clear military strategy and costs spiraling beyond $1 billion doomed the program. In December of 1963, McNamara labeled the X-20 project a "billion dollar turkey" and summarily canceled the program.[182] Nonetheless, the spaceplane project demonstrated America's willingness to expand the notion of airpower to the new realm of space. In a technological age bounded by nuclear Armageddon nightmares, the high ground of space and the role of military astronauts in strategic warfare was a tantalizing subject. Recognizing this pervasive belief, the Soviets covertly pursued

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[178] Godwin, *Dyna-Soar*, 45.
[179] *Dyna-Soar General Management Proposal/System, 464L* (Seattle, WA: Boeing Airplane Company, 1958). M-29111-7-S, 2-2603.
[180] William E. Burrows, *This New Ocean* (New York: Random House, 1999), 254.
[181] Burrows, *This New Ocean*, 254.
[182] Burrows, *This New Ocean*, 254.

their own versions of the Sanger-Brendt spaceplane in the hopes of achieving military advantage.

Much like in the United States, Soviet prestige spaceflights performed under the *Vostok* and *Voshkod* programs greatly overshadowed alternative spaceplane efforts aimed at addressing state fear under Type 1 exploration. Not until the 1980s, under Premier Mikhail Gorbachev's *Glasnost* (Openness) initiatives, were Soviet records declassified sufficiently to reveal the existence of no less than five design bureau efforts to construct a piloted military spaceplane in the 1950s and 1960s.[183]

Within the *Korolyov* design bureau, designer Pavel Tsybin produced plans for the *PKA* (Gliding Space Apparatus).[184] The *PKA* was a single seat spaceplane designed to fit atop an R-7 booster, achieve orbital altitudes of 186 miles, and perform military missions lasting up to 27 hours.[185] Rival design bureau OKB-23, under the direction of Vladimir Myasishchev, worked on a series of reusable intercontinental rocket planes that would perform strategic reconnaissance using advanced optical, radar, and infrared sensors.[186] In the OKB-156 design bureau, famed Soviet aircraft designer Andrey Tupolev advanced proposals for his *Zvezda* (Star) spaceplane; a 20-ton canard and delta wing shaped vehicle designed for reconnaissance, bombing, and anti-satellite missions.[187] Artyom Mikoyan's OKB-155 design bureau, renowned for its legendary series of Mikoyan-Gurevich or *MiG* fighter aircraft, investigated an ambitious 115 ton, piggyback spaceplane and hypersonic launching aircraft combination known together as *Spiral*.[188] Mikoyan's work on the *Spiral* project would eventually prove of great

[183] Hendrickx and Vis, *Energiya-Buran*, 17.
[184] Hendrickx and Vis, *Energiya-Buran*, 20.
[185] Hendrickx and Vis, *Energiya-Buran*, 20.
[186] Hendrickx and Vis, *Energiya-Buran*, 22-25.
[187] Hendrickx and Vis, *Energiya-Buran*, 26-28.
[188] Hendrickx and Vis, *Energiya-Buran*, 32.

merit to the development of the *Buran* (Snowstorm) Russian Space Shuttle nearly three decades later. However, the most audacious counter proposal to the American Dyna-Soar spaceplane originated from Vladimir Chelomey, Sergei Korolev's nemesis rocket design rival.

Chelomey's *Raketoplan* (Rocket Glider) was to serve as a reusable intercontinental space bomber. The detailed proposal for *Raketoplan* involved a spaceplane that would launch atop a conventional booster and then use high performance turbojets to maneuver in suborbital flight.[189] Studies indicated that variants of *Raketoplan* would have ranges between 4,900 miles and 24,800 miles.[190] Launched south into a Polar orbit from any latitudes within the Soviet Union, the longer range versions of *Raketoplan* could overfly Antarctica to evade American early warning nets and attack targets, such as Washington DC, from the southern hemisphere.[191] *Raketoplan* received official Politburo support for development on 23 June 1960.[192] The same Politburo decree also consolidated all spaceplane research efforts from the other design bureaus under the authority of Chelomey's OKB-52 organization.[193] Design work continued on the project well into 1964,

Figure 32: Raketoplan Concept

Source: Dr.Vadim P. Lukashevich, "Raketoplan," http://www.astronautix.com/craft/rakoplan.htm , Accessed 21 April 2011).

[189] Asif A. Siddiqi, *Challenge to Apollo: The Soviet Union and the Space Race 1945-1974,* NASA SP-2000-4408, 231.
[190] Siddiqi, *Challenge to Apollo*, 231.
[191] Siddiqi, *Challenge to Apollo*, 231.
[192] Hendrickx and Vis, *Energiya-Buran*, 28.
[193] "Raketoplan", *Russian Space Web*, http://www.russianspaceweb.com/raketoplan.html (Accessed 26 February 2011).

culminating in the production and sub-orbital flight of two sub-scale test vehicles.[194]

However, political and economic realities doomed *Raketoplan* in much the same way as the American Dyna-Soar project. Chelomey lost tremendous political support when Politburo elites forcefully removed his prime benefactor, Premier Khrushchev, from power. Khrushchev's replacement, Premier Leonid Brezhnev, preferred the technical expediency and cost savings of ICBMs and reconnaissance satellites in his quest to expand Soviet strategic power in the disastrous wake of the Cuban Missile crisis. In light of Dyna-Soar's cancellation, Soviet political leadership viewed pursuit of the *Raketoplan* as wasteful.

Ultimately, spaceplane projects in both nations failed in the 1960s primarily due to their limited mission focus, expense, and long development times. Within the context of the Cold War, the military benefits of operationally responsive hypersonic reconnaissance, orbital nuclear bombardment, and enemy satellite destruction required an actual nuclear war to achieve fruition. Considering the extreme costs associated with developing, producing, and operating vehicles such as Dyna-Soar or *Raketoplan*, ICBMs and satellites were a more attractive alternative to address the possibility of global nuclear war. However, as plans for a spaceplane waned in the mid-1960s, military planners in both nations sought alternative human spacepower technologies designed to more effectively address fear during both peace and wartime.

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194 194 "Raketoplan", *Russian Space Web*, (Accessed 26 February 2011).

Orbiting Battle Stations

On the day following Dyna-Soar's cancellation, Secretary McNamara approved an alternative USAF project designed to exploit the advantages of military Airmen in orbit.[195] In McNamara's view, independent defense studies in the early 1960s indicated that a military space station, cannibalizing much of the existing technology and experience developed for NASA's Gemini program, could effectively accomplish much of Dyna-Soar's original mission at a significantly reduced cost and quicker development schedule.[196] The resulting project, known as the Manned Orbiting Laboratory (MOL), emerged amidst furious turf and budgetary battle between NASA and the Department of Defense over the proper role of military and civilian personnel in space.[197] In an effort to resolve this debate, the DOD loosely defined MOL's primary goal as, "to learn more about what man is able to do in space and how that ability can be used for military purposes."[198] More specifically, the primary missions of MOL included general reconnaissance, reconnaissance of given spots on request, post-strike reconnaissance, continuous surveillance, and ocean reconnaissance.[199] Assuming the success of these primary roles, additional mission functions would expand to include bombardment, inspection of unknown space vehicles, command and control, and operational support to terrestrial and space military forces.[200]

Mission design requirements for MOL stipulated a station size roughly equivalent to a small house trailer, a design orbit of 350 miles,

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[195] Burrows, *This New Ocean*, 254.
[196] Walter A. McDougall, *...Heavens and the Earth* (Baltimore, MD: John Hopkins, 1985), 340.
[197] Philip Baker, *The Story of Manned Space Stations* (Chichester, UK: Praxis, 2007), 10.
[198] Burrows, *This New Ocean*, 255.
[199] Burrows, *This New Ocean*, 256.
[200] Burrows, *This New Ocean*, 256.

and the ability to support a crew of two USAF officers in a shirtsleeve style environment for missions lasting up to 45 days.[201] Crews would transfer from Earth to the MOL in a USAF version of the Gemini capsule known as Gemini-B; a spacecraft that differed most notably from its civilian counterpart by the addition of circular hatch cut through the base of the heat shield to allow access between the space station and the capsule.[202] Stacked together, the Gemini-B and MOL would rocket to orbits as high as polar inclination atop a single Titan IIIC booster launched from Vandenberg AFB.[203] Once on orbit, MOL would serve as a highly flexible platform uniquely adapted to compete with the growing constellation of unmanned satellites. Air Force deputy chief of staff for research and development, Lieutenant General James Ferguson, encapsulated the USAF's primary argument for the program at a Congressional hearing.

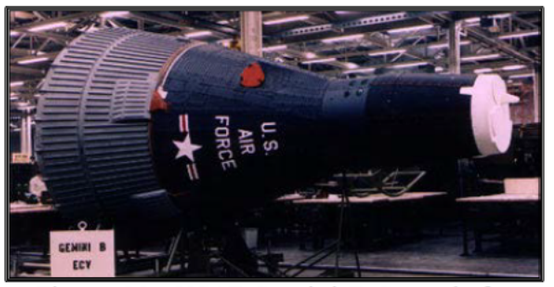

Figure 33: USAF Gemini-B Capsule for Department of Defense Missions to MOL

Source: USAF, "Gemini-B,", http://space.skyrocket.de/doc_sdat/gemini-b.htm , (Accessed 2 May 2011).

> Man has certain qualitative capabilities which machines cannot duplicate. He is unique in his ability to make on-the-spot judgments. He can discriminate and select from alternatives which have not been anticipated. He is adaptable to rapidly changing situations. Thus, by including man in the military space systems, we significantly increase the flexibility of the systems, as well as increase the probability of mission success.[204]

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[201] Burrows, *The New Ocean*, 255.
[202] "Gemini Spacecraft," *National Museum of the Air Force*, http://www.nationalmuseum.af.mil/factsheets/factsheet.asp?id=551 (Accessed 10 March 2011).
[203] Baker, *The Story of Manned Space Stations*, 10.
[204] Burrows, *This New Ocean,* 255.

Development work on MOL commenced followed President Lyndon Johnson's 25 August 1965 program approval. Efforts included the construction of the Space Launch Complex 6 at Vandenberg Air Force Base, recruitment of 14 military test pilots, and the uninhabited test launch of a Gemini-B and surrogate MOL station aboard a Titan booster.[205] Yet, the extraordinary price tag of the moon missions and increasing sophistication of uninhabited satellites doomed MOL in much the same way as its spaceplane predecessors. By April of 1969, significant schedule delays and budget cuts slipped the first flight of MOL by over several years to 1972.[206] Later in 1969, with program costs soaring beyond $1.3 billion, President Richard Nixon finally canceled MOL.[207] Regardless of its cancellation, the impact of MOL created deep reverberations within the Russian defense establishment.

Figure 34: Gemini-B and MOL Surrogate atop Titan III on Test Launch

Source: *NASA*, http://www.nasa.gov/centers/kennedy/about/history/

The Soviets, ever vigilant to American military spaceflight developments, proposed a series of military space stations as a counter to MOL. However, unlike their American counterparts, the Soviets actually built and flew operational versions of their designs. The primary strategic reason for this difference between the progress of the American and Soviet space programs originated from the Soviet's shift to long duration space station style missions in the mid-1960s upon realizing the moon was lost to the Americans. With the sudden death of Korolev and Chelomey's resurgence and consolidation of power within the Soviet

[205] Baker, *The Story of Manned Space Stations*, 10-11.
[206] Burrows, *This New Ocean*, 256.
[207] Baker, *The Story of Manned Space Stations*, 14.

space program, Soviet scientific and military space goals were in harmony. This harmony, at significant contrast to the dissonance between US civil and military establishments in the late 1960s, resulted in the greater efficiency of bringing concepts to fruition. In keeping with the themes of secrecy endemic within the Soviet space program, the state hid these military space stations under the civil scientific *Salyut (*Salute) program.[208] *Salyut* 2, 3, and 5 were in reality military space stations, differing from their civilian counterparts by the addition of advanced surveillance gear, the use of frequencies reserved for Soviet military telemetry, lower orbits to improve optical surveillance resolution, and a higher degree of automation.[209] Stations in this configuration flew under the secret codename *Almaz* (Diamond).[210] *Salyut* 3, in particular, was uniquely equipped with a 23mm cannon designed to destroy enemy satellites or prevent hostile boardings by American spacecraft.[211] Rather than using a complex gun turret, the weapon was instead bolted to one end of *Almaz* and bore-sighted along the long axis of the station. Hence, to aim the gun, cosmonauts would need to reorient the entire station using the reaction control system. Soviet space archives record that this weapon fired only once while on orbit. Ground controllers remotely test fired *Salyut 3's* cannon prior to de-orbiting the station on 24 January of 1975.[212] Although the results of this test are not public record, the Soviets never again fielded a spacecraft equipped with cannon.

Despite tremendous Soviet investment in the *Almaz* program, the legacy of these military stations remains dubious. *Salyut* 2 (*Almaz* 1),

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[208] Nicholas L. Johnson, *Handbook of Soviet Manned Space Flight*, (San Diego, CA: Univelt, 1980) 213-217.
[209] Baker, *Manned Space Stations*, 46.
[210] David M. Harland, *The Story of Space Station MIR*, (Chichester, UK: Praxis Publishing, 2005), 9.
[211] Baker, *Manned Space Stations*, 49.
[212] Baker, *Manned Space Stations*, 51.

launched in 1973, suffered a catastrophic fire and explosion 13 days after achieving orbit.[213] After 55 days of derelict spaceflight, its orbit decayed into Earth's atmosphere after never receiving a crew.[214] The only crew to occupy the follow on station, *Salyut 3* (*Almaz 2*), spent 15 days on board and successfully activated the reconnaissance gear to photograph several test targets arrayed near Baikonur.[215] The second planned crew of *Salyut 3*, however, returned to Earth only two days after launch when faulty rendezvous equipment prevented station docking.[216] Delays in solving the rendezvous equipment failure caused no further expeditions to *Salyut 3*. After seven months of spaceflight, spending 93% of its life unoccupied, *Salyut 3* de-orbited over the Pacific Ocean.[217] *Salyut* 5, launched in 1975, was successfully used by the crew of *Soyuz 21* to monitor a Soviet military exercise in Siberia.[218] However, the crew abandoned the station early due to fears over air contaminants in the space station's cabin and reported crew interaction difficulties. The Soviets launched two more expeditions to *Salyut 5*; one was unable to dock and the other only used *Salyut 5* as a test bed to evaluate station atmosphere purging techniques.[219] There would be no further mission to *Salyut 5* before the Soviets de-orbited the station on 8 August 1977.[220] *Salyut 5's* fiery re-entry trail across the sky became a Viking funeral that marked the last purely military space station of any nation.

The saga of the orbital spaceplanes and battle stations reveals an important phenomena concerning military human spaceflight. Intense schedule, cost, and technical feasibility pressures doomed the ambitious Dyna-Soar, MOL, *Almaz*, and *Raketoplan* programs nearly from the

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[213] Baker, *Manned Space Stations*, 51.
[214] Johnson, *Handbook of Soviet Manned Space Flight,* 215.
[215] Baker, *Manned Space Stations*, 51.
[216] Baker, *Manned Space Stations*, 51.
[217] Baker, *Manned Space Stations*, 51.
[218] Baker, *Manned Space Stations*, 58.
[219] Baker, *Manned Space Stations*, 59.
[220] Baker, *Manned Space Stations*, 60.

cradle. Only one of the four military programs, *Almaz*, made it from concept to operations. However even this program was quickly abandoned due to limited operational utility in the face of uninhabited systems. Advances in ICBMs, satellite surveillance, and global communications technology obviated the need for humans to perform these types of missions from orbit. Both nations followed their own tortuous path to arrive at the same conclusion; uninhabited spaceflight for this class of mission may be expensive, but has significantly more economic utility, pound for pound, than sending a human to perform the same task given the current technocratic paradigm.

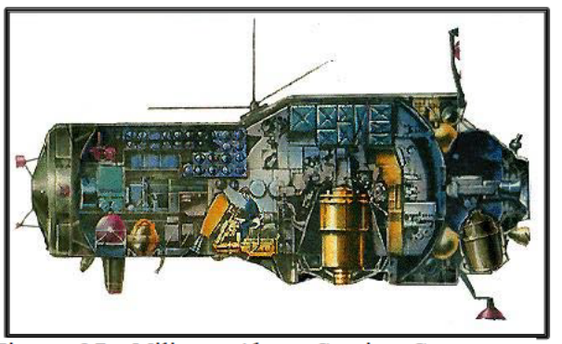

Figure 35: Military *Almaz* Station Cutaway with Crewmember using the Surveillance Camera

Source: VideoKosmos, "Almaz," http://www astronautix.com/project/almaz.htm, (Accessed 12 April 2011)

Yet, not all Type 1 explorations during this era focused on human spaceflight as a means to win global war. In the middle of the 1970s, a joint mission between the United States and the Soviet Union investigated another potential exploitation of the domain of space; using human spaceflight to address national security fear through outward gestures of peace.

The Handshake seen around the World

The geo-strategic context of the 1970s featured several important events. In a move to bolster Soviet security and regain power around the world, Premier Brezhnev instituted a massive nuclear weapons

development program to make up for the missile gap.[221] Brezhnev's program caused the Soviet Union to achieve parity and then exceeded the nuclear capabilities of the United States in terms of raw numbers.[222] However, this massive military buildup was proving to be financially costly for the Soviet Union. In addition, the Soviets were fearful of a deepening split within the communist world because of warming relations between Beijing and Washington DC following President Richard Nixon's famous visit to China in 1972.[223] In the United States, Defense Secretary McNamara realized that nuclear stockpiles of both nations had risen to such absurdity that Mutually Assured Destruction (MAD) would result from any nuclear conflict.[224] Compounding these fears was a deepening American financial crisis and tumultuous domestic strife over US military involvement in the Vietnam War.

Worldwide, an overriding milieu of wartime exhaustion, nuclear fear, and uncertainty cast a pall over international relations. As a result, conditions were ripe for both the United States and the Soviet Union to seek a thaw in the Cold War. Ultimately, this geo-strategic initiative to relax tensions culminated in the historic Strategic Arms Limitations Treaty (SALT) negotiations and agreements.[225] Given the tremendous symbolic significance attached to human spaceflight in the early space race, Soviet and American leaders naturally looked to the space program as a means to foster Détente. Within the United States, the means to wage peace via space technology was born in the ashes of the Apollo moon program.

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[221] Lawrence Freedman, *The Evolution of Nuclear Strategy* (New York: Palgrave, 2003), 300.
[222] Freedman, *The Evolution of Nuclear Strategy*, 329.
[223] Stephen R. Randolph, *Powerful and Brutal Weapons* (Cambridge, MA: Harvard, 2007), 25.
[224] Freedman, *The Evolution of Nuclear Strategy*, 234-236.
[225] Freedman, *The Evolution of Nuclear Strategy*, 338.

In the aftermath of the Apollo moon landings, NASA struggled to find a new direction for the space program. Waning funding and public attention no longer supported outsized government spending for voyages to the moon. NASA canceled the Apollo 18 through 20 lunar missions and converted the hardware to support the Apollo Applications Program (AAP); a project created in 1965 to provide a post Apollo strategy for America's civil space program.[226] By the early 1970s, grandiose AAP visions of extended missions to the moon curtailed to match political and economic realities. Nonetheless, AAP still managed to contribute greatly to America's scientific understanding of astronomy and long duration spaceflight by producing the Skylab space station. It also contributed to addressing American nuclear Armageddon fears by providing the equipment and expertise necessary to execute the Apollo-*Soyuz* Test Project.

In the spirit of Détente, President Nixon and Soviet Premier Aleksei Kosygin signed a multi-year agreement on 24 May 1972 to fly a joint space mission in 1975 in hopes of fostering the peaceful use and exploration of space.[227] The agreement resulted in numerous scientific and cultural exchanges between members of both the American and Soviet space program. Considering the remarkable secrecy of the Soviet space program and institutionalized distrust between the two nations, the open sharing of

Figure 36: Colonels Stafford and Leonov Pose with a Commemorative ASTP Plaque

Source: NASA History Office, "The Apollo Soyuz Test Project Image Gallery," *NASA*, http://history.nasa.gov/astp/kipp.html (Accessed 24 April 2011)

[226] Launius, *Space Stations*, 69.
[227] Burrows, *This New Ocean*, 447.

sufficient technical information to allow the successful launch, rendezvous, and docking of two completely different spacecraft was nothing short of remarkable.

Soyuz 19, commanded by Soviet Colonel Alexei Leonov (the world's first spacewalker), launch from Baikonur on 15 July 1975.[228] Seven and a half hours later, the Apollo crew, commanded by Air Force Colonel Tom Stafford blasted off from Kennedy Space Center.[229] Two days later, the two capsules joined in orbit. Before a worldwide television audience of millions, Colonel Stafford and Colonel Leonov opened the hatchway connecting the two capsules and exchanged a hearty handshake. The handshake, the culmination of over three years of close cooperation between the Soviet Union and the United States, was the penultimate symbol of Détente.

However, following the historic Apollo-*Soyuz* mission, the thaw of Détente quickly faded, replaced instead by a return to hardening Cold War stances. By the early 1980, the Soviets invaded Afghanistan, President Jimmy Carter boycotted the Moscow Olympics in protest, and the US backed Shah of Iran was replaced by the Ayatollah Khomeini in the Iranian Revolution.[230] The United States increased defense spending under the administration of President Ronald Reagan and the Soviet Union's political leadership went into turmoil following the death

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[228] Baker, *The Story of Manned Space Stations*, 56.
[229] Burrows, *This New Ocean*, 448.
[230] "Iranian Revolution", *Nova Online*, http://novaonline.nvcc.edu/eli/evans/his135/Events/Iran79.htm (Accessed 18 February 2011),
James Phillips, "The Soviet Invasion of Afghanistan," *The Heritage Foundation*, http://www.heritage.org/research/reports/1980/01/the-soviet-invasion-of-afghanistan (Accessed 10 March 2011),
Pierre Tristan, "The 1980 Olympics Boycott over the Soviet Invasion of Afghanistan", *Middle East Issues*, http://middleeast.about.com/od/afghanistan/a/me080803.htm (Accessed 11 March 2011).

of Premier Brezhnev.[231] These developments highlighted another important lesson for human spaceflight in addressing pragmatic national security fears; noble achievements in space for peace will most likely not have sufficient momentum to trump Earth bound realities.

The bright geo-strategic spotlight of Apollo-*Soyuz* and the spirit of Détente that it represented was no more. Within the context of the space program, these hardening relations reflected in each country's view of an emerging security dilemma caused by a new round of spaceplane technology.

The Space Shuttle vs. Buran Security Dilemma

In January of 1972, President Richard Nixon approved the development of the Space Shuttle as the follow on to the Apollo program.[232] As a reusable vehicle capable of performing a variety of space missions in low earth orbit, the Space Shuttle was a radical departure from the Type 2 cosmos exploratory visions of the Apollo program. Instead, the space shuttle was a Type 1 exploration program designed to exploit space for routine

Figure 37: The Space Shuttle served as both a Military Spaceplane and Civil Spacecraft

Source: *NASA*, http://www.nikon.com/news/2005/0907_nasa_01.htm (Accessed 23 April 2011).

[231] "1982: Brezhnev rumors sweep Moscow," *BBC*, http://news.bbc.co.uk/onthisday/hi/dates/stories/november/10/newsid_2516000/2516417.stm, (Accessed 20 April 2011); and "Ronald Reagan's Military Buildup," *US History*, http://www.u-s-history.com/pages/h1957.html, (Accessed 30 April 2011).
[232] Harland, *The Story of the Space Shuttle*, 6.

operations. As stated in a June 1973 Government Accounting Office (GAO) report to Congress.

> NASA believes that the principal tasks of the Space Shuttle are to (1) reduce the cost of space operations and (2) provide a future capability to support a wide variety of scientific, defense, and commercial uses of space. Two specific objectives of the Shuttle are to (1) maintain use of manned space missions, which some think could be performed remotely if the conventional launch systems (which have limited capability for manned missions) were used, and (2) transport the equipment used in these and other missions back to Earth. The space shuttle is intended to place satellites in orbit, retrieve satellites from orbit, and permit on orbit repair and servicing of satellites.[233]

The Shuttle's astronomically high initial costs were justified based on the long-term dramatic financial reductions to orbital launch costs. In order to produce this effect, NASA's initial estimates to Congress projected 779 flights between 1979 and 1990, each flown to maximum payload capacity with an average launch cost to orbit of $160/lbs.[234] These figures were heavily contested at the time by outside agencies as being wildly overestimated. The only strategy remotely capable of reaching these mission rates was to make the Space Shuttle America's sole means of launching payloads to Earth orbit. The US government proposed removing expendable boosters from service, such as Titan or Atlas, as they were redundant to the Space Shuttle capabilities.[235] The

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[233] United States General Accounting Office, *Analysis of Cost Estimates for the Space Shuttle and Two Alternatives*, B-173677 (Washington, DC: Government Printing Office), 5.
[234] United States General Accounting Office, *Analysis of Cost Estimates*, 10 & 31.
[235] The Department of Defense was never completely comfortable with relying upon the Space Shuttle as the primary means of launching defense payloads to orbit. While expendable boosters were discarded from use during this era, many within the defense establishment advanced expendable booster development quietly. In wake of the Space Shuttle Challenger disaster, the USAF removed the majority of DOD payloads from the Space Shuttle, canceled plans to launch the Space Shuttle from the Vandenberg launch complex, and returned expendable boosters, such as Atlas and Delta back to service.

DOD reluctantly agreed to this plan provided the Space Shuttle met several stringent design requirements.

For example, the DOD envisioned launching the Space Shuttle on operationally responsive polar inclination military missions from Vandenberg Air Force Base.[236] The United States Air Force petitioned for a dedicated DOD Space Shuttle; serviced and launched from Vandenberg's Air Force Base's Space Launch Complex 6 originally built for the MOL program.[237] Defense Department requirements also stipulated the design of the Space Shuttle's large delta wings to preserve sufficient cross-range flight capability to land at Vandenberg or Edwards Air Force Base after one polar orbit.[238] In addition, the design of the Shuttle's large 60' by 15' cargo bay was a direct result of the Defense Department's specifications to carry the largest and heaviest National Reconnaissance Office (NRO) satellites to orbit.[239] The Department of Defense also stipulated maintaining a large military presence within the astronaut cadre to facilitate the execution of classified missions. For the first decade of Space Shuttle operations, the United States Air Force and National Reconnaissance Office detailed several military officers to the NASA astronaut office under the Manned Spaceflight Engineer

Figure 38: First Class of Military Spaceflight Engineers

Source: *USAF*, "The Manned Spaceflight Engineer Program," http://epizodsspace.testpilot.ru/bibl/spaceflight/31/mse.html, (Accessed 25 April 2011).

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[236] National Aeronautics and Space Administration, *Columbia Accident Investigation Report*, (Washington, DC: NASA, August 2003), 22.
[237] Harland, *The Story of the Space Shuttle*, 6.
[238] National Aeronautics and Space Administration, *Columbia Accident Investigation Report*, 10.
[239] National Aeronautics and Space Administration, *Columbia Accident Investigation Report*, 10.

(MSE) program.[240] Different from career astronauts recruited from the military services, MSEs were DOD military officers specially detailed to NASA as payload specialists aboard classified space shuttle missions.[241] Overall, 32 MSEs were selected by the USAF. However, internal friction between NASA and the DOD over the classified payload specialist program greatly reduced the role of the MSEs. Low shuttle launch rates, and the return of the DOD to expendable boosters following the Challenger disaster resulted in the spaceflight of only two of the original 32 MSEs.[242] Ultimately, the Space Shuttle flew only 11 dedicated classified missions between its inaugural flight in April of 1981 and final military mission in 1992. These missions launched classified satellites from the Space Shuttle's cargo bay and conducted classified surveillance experiments.[243] By far, the vast majority of Shuttle missions were dedicated to scientific research and civil purposes.

Despite becoming an amazing testament to American technological accomplishment, the Space Shuttle proved to be far less operational resilient and tremendously more expensive than originally planned. For example, current NASA estimates place the cost of a single Space Shuttle launch at $450 million.[244] Independent estimates currently place this figure at closer to $1.5 billion per launch once the costs of infrastructure and overhead amortize over the life of the Space Shuttle program.[245] Either figure, however, is wildly above the initial 1972 estimate of approximately $40 million per launch in 2010

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[240] Michael Cassut, "Secret Space Shuttle", *Air and Space Smithsonian*, http://www.airspacemag.com/space-exploration/Secret-Space-Shuttles.html, 1 August 2009 (Accessed 10 March 2011).
[241] Cassut, "Secret Space Shuttle," (Accessed 10 March 2011).
[242] Cassut, "Secret Space Shuttle," (Accessed 10 March 2011).
[243] Cassut, "Secret Space Shuttle," (Accessed 10 March 2011).
[244] "NASA Space Shuttle and International Space Station Frequently Asked Questions," http://www.nasa.gov/centers/kennedy/about/information/shuttle_faq.html, *NASA*, , (Accessed 18 May 2011).
[245]Roger Pielke Jr and Radford Byerly, "Shuttle Programme Lifetime Cost," *Nature*, 7 April 2011, http://rogerpielkejr.blogspot.com/2011/04/space-shuttle-costs-1971-2011.html (Accessed 22 May 2011).

inflation-adjusted dollars.[246] This huge ballooning in costs are directly attributable to the vast complexity of the Space Shuttle vehicle and program infrastructure, as well as gross underestimates of vehicle processing turnaround times between missions. As a result, far from estimates of one Space Shuttle launch per week, the Space Shuttle averaged only approximately four launches per year over its three-decade history. This paucity in launch rate further accelerated overall launch cost per mission. Ultimately, these huge increases in cost coupled with a lack of operationally responsive space lift condemned the military utility of the Space Shuttle. Nonetheless, fear of the military potential of the Space Shuttle shocked the Soviet space program to produce a shuttle of its own.

The Soviets viewed the Space Shuttle as a super Dyna-Soar like strategic weapon. By examining the nearly fictional Space Shuttle cost and utilization projections in the 1970s, the Soviets suspected a public rouse to conceal a secret military use for America's new spaceplane. From the Soviet perspective, the Space Shuttle's true purpose was to serve either as an orbital nuclear bomber or as a military spaceplane capable of capturing, examining, or disabling Russian military satellites.[247] As a counter to this supposed threat, the Soviets engaged on a 15 billion-ruble

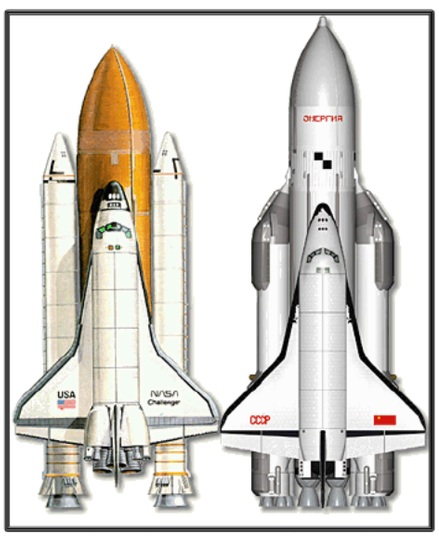

Figure 39: Shuttle vs. *Buran* Design

Source: "Buran Orbiter," *Russian Space Agency*, http://www.buran.ru/htm/molniya5.htm (Accessed 14 April 2011).

[246] National Aeronautics and Space Administration, *Columbia Accident Investigation Report*, 22.
[247] Hendrickx and Vis, *Energiya-Buran*, 32.

crash development program to develop *Buran* (Snowstorm).[248]

The design similarity between Buran and the Space Shuttle was a direct reflection of Soviet fears. Rather than investing in a design specifically tailored to Russian needs, the Soviet space program leadership found it more expedient to copy the openly available design specifications of the US Space Shuttle.[249] This strategy allowed the Soviets to match US capabilities, even if they were unsure as to the exact strategy the US intended for the Space Shuttle.[250] However, *Buran* featured some changes over the Space Shuttle, namely a fully autonomous flight capability and the provision for two remote manipulator system arms to aid in the capture and exploitation of American satellites.

Figure 40: *Buran's* Autonomous Landing at Baikonur following its First, and Only, Orbital Flight

Source: "Reentry of the Buran Space Shuttle," *Russian Space Agency*, http://www.columbiassacrifice.com/pages_support/$buran.htm (Accessed 18 May 2011).

However, the Soviet approach of developing a means without an end proved their undoing. After only one uninhabited flight lasting two orbits, the *Buran* program collapsed with the implosion of Soviet communism. Despite the Soviet's amazing technical accomplishment, the end of the Cold War undercut the fundamental fear that provoked the need for *Buran*.[251] In essence, the Soviets had reached the strategic overreach point as outlined by the Exploration Model's Type 1 criteria.

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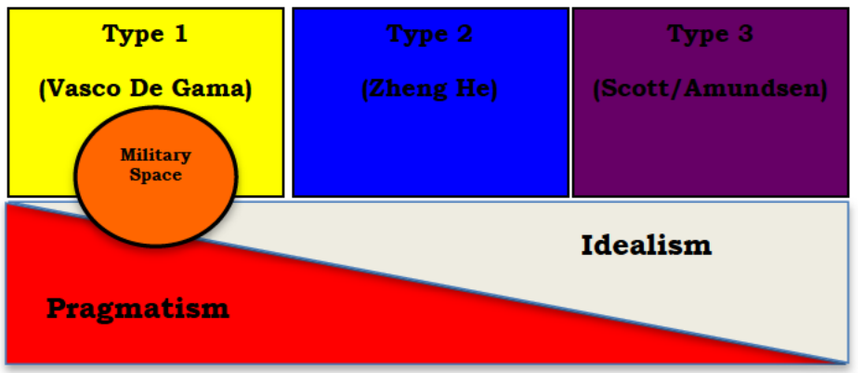
[248] Burrows, *This New Ocean*, 517.
[249] Burrows, *This New Ocean*, 517.
[250] Harland, *The Story of Space Station MIR*, 317.
[251] Hendrickx and Vis, *Energiya-Buran*, 385-392.

Conclusions



Human spaceflight during this era was endemic of Type 1 exploration initiated from the catalyst of national security fear. The new domain of space encouraged innovative searches by both the Soviet Union and the United States for the best means to exploit this novel frontier for military advantage. Generally, states funded these investigations sufficiently well until their approaches became obsolete or incapable of addressing national security fear. While these explorations into new uses for space spurned great advances in human knowledge, these enhancements were incidental to the need to exploit space for practical, competitive advantage. This era highlighted several important dynamics when national security fear is the spark of human spaceflight exploration.

The fate of the Soviet Buran Shuttles reads like a Greek tragedy. Of the 5 *Burans* built by the Soviets, only 1 flew in space. This *Buran*, designated 1K, was destroyed in 2002 during a storm when the hangar it was stored in collapsed on top of it. Of the remaining *Burans*, BTS-002, was leased by a private group of investors and became a static display at numerous public events including the Sydney Olympic games in 2002. However, legal and financial disputes between various private organizations resulted in BT-002 languishing in limbo in a Bahraini junkyard. It remains there today. The *Buran* designated as OK-M is now a tourist attraction in Gorky Park. Visiting tourist are seated in the former cargo bay, now a multi-seat movie theater, and treated to images and videos highlighting the past glory of the Soviet space program. The electrical test bed *Buran*, designated OK-KS, and test model *Buran*, designated OK-TVI, remain indefinitely in partially disassembled storage in Russia.

The most important concerns the gross mismatch between the glacially slow development of military human spaceflight programs and the blazingly fast pace of change in global security dynamics. While these military human spaceflight programs were technically sound and held promise for addressing pragmatic national security fears, they all suffered from high cost and schedule paralysis. Since the birth of the space program, Earth bound spiraling security dilemmas fueled rapid changes in weapons and surveillance technology that often rendered national defense human spaceflight programs obsolete on the drawing board. The vast complexity and cost of human spaceflight, coupled with poor management, resulted in tenuous political support at best. The shorter development cycle of ICBMs and surveillance satellites made uninhabited systems a much more viable and attractive alternative to address changing security conditions. For much lower costs, uninhabited systems swiftly outpaced the capabilities and flexibility of equivalent human spaceflight programs for the missions of intelligence, surveillance, and strike. This trend makes the current paradigm of human spaceflight development ill-suited for direct national security applications.

Second, the history of the Apollo-*Soyuz* Test Project disproves the often-held myth that peace and cooperation in space yield peace and cooperation on Earth. Instead, harmony in space must be the natural outgrowth of global accord on Earth, not the other way around. The tremendous success of the ASTP could not overcome the inertia of fear, distrust, and global ambition between the United States and the Soviet Union.

Third, while technology development in Type 1 explorations tend to be reasoned, campaigns sparked by fear can push state actions to distort enemy intentions and capabilities far beyond the bounds of reality. The security dilemma nightmares of the state, without check,

can force rash decisions. The high costs and development time associated with human spaceflight programs greatly magnify the impact of this phenomenon and can accelerate the plunge towards strategic overreach. For example, the obsessive paranoia over the perceived doomsday mission of the Space Shuttle in the communist world contributed to the economic collapse of the Soviet Union. The feverish design and construction of *Buran*, no matter its technical merits, proved wholly ill-conceived and was virtually stillborn after only one flight. Spacepower strategist must therefore be especially wary of the tendency for strategic overreach with respect to human spaceflight.

Fourth, just as in previous exploration campaigns, pragmatic human space exploration under Type 1 can create spin off benefits directed at idealistic principles. Specifically, the added risk associated with human spaceflight creates added incentive for robust spaceflight systems that can have lasting benefit for humankind. While nothing of the transcendent idealist principles present in the moon missions were evident in the original objectives for these military space campaigns, they did produce several incidental benefits to human society. For example, development work for Dyna-Soar led to technologies useful for the Space Shuttle; the backbone of America's scientific space program for the previous three decades. *Almaz* developments led to the evolution of *Salyut* and *Mir*; space stations that have greatly contributed to human bio-medical and long duration spaceflight experience and understanding.

Hence, by the late 1980s and 1990s, the use of human spaceflight for pure military applications had run its course. Uninhabited systems superseded using humans to perform the missions of intelligence, surveillance, reconnaissance, and global strike from space. Instead, the quest for the exploitation of space shifted from Type 1 military

applications to Type 1 explorations designed to advancing state soft power and economic interests.

Chapter 5

A SPACE ODYSSEY OF STRANGE FELLOWS

Exploration Model and Space Stations: 1977-2010

When I was flying missions in Vietnam in 1969 as an F-4 pilot, I thought that there was an excellent chance that at some point in time I'd have interactions with the Russians, but I thought it would be of a somewhat different nature than they turned out. If anyone in 1969 had ever told me that I would wind up having a captain in the Russian force as a commander, I would have said, 'You're crazy.'

Norman Thagard, USMC Captain (ret.), 1st US astronaut to crew the Russian space station *Mir*

Pragmatic notions of national interest encompass a state's quest for advantage, profit, and benefit. During the late 1970s and beyond, this catalyst sufficient condition replaced fear as the motivator for Type 1 exploration. Rather than flights beyond cis-lunar space, both superpowers sought to innovate the exploitation of space by using human spaceflight as a tool to achieve state interests. While non-existential, both states viewed this use of human spaceflight as important for achieving the goals of grand strategy. This quest by the Americans and Soviets resulted in a tremendously uncanny array of international relationships. In the early half of this era, both nations turned to space stations as a means to consolidate influence within each state's respective political alliances. By the late 1980s and early 1990s, as small tears in the Iron Curtain ripped apart into gaping holes, the utility of space stations morphed into a method to globally sponsor cooperation, generate economic benefit, and expand influence. This trend slowly helped to transform arch Cold War rivals into globalization allies. Understanding the international and domestic backdrop for the odysseys of *Salyut* 6 and 7, Space Station Freedom, the Shuttle-*Mir*

program, and the International Space Station helps to highlight this strange marriage between Type 1 exploration, space station technology, and pragmatic national interest.

Ambassador *Salyut*

The *Salyut* program, in addition to bolstering Soviet scientific efforts and serving as a cover for the secret military *Almaz* program, also performed a unique political function. Key to the fulfillment of this political purpose was the technical design of *Salyut* 6 and 7. These two space stations featured a new two port docking system that allowed long-term crews to accept visitors. The short-term crew could dock with the station, perform a mission lasting approximately a week, return to Earth using the older *Soyuz* capsule, and leave the newer *Soyuz* capsule as a lifeboat for the long-term crew.[1] This design feature enabled the *Inter-Kosmos* and *GlavKosmos* programs; a series of flights in which the Soviets flew guest cosmonauts from foreign states in a strategic effort to advance national interests.[2]

Figure 41: *Salyut* with Docked *Soyuz*

The 2nd Docking Port is Open at the Top of Picture

Source: "Salyut Program," *Russian Space Agancy*, http://reference.findtarget.com/search/Salyut%20program/ (Accessed 28 April 2011).

[1] Roger D. Launius, *Space Stations: Base Camps to the Stars* (Washington, DC: Smithsonian, 2003), 101.
[2] Philip Baker, *The Story of Manned Space Stations* (Chichester, UK: Praxis, 2007), 62.

Salyut 6, launched on 29 September 1977, became the first station to host a guest flight engineer cosmonaut under the *Inter-Kosmos* program.[3] Czechoslovakia's Vladimir Remek, Czech air force pilot and the son of a high-ranking Czech defense minister, flew to *Salyut* 6 on the tenth anniversary of the Soviet invasion of Czechoslovakia.[4] As stated by international relations professor Michael Sheehan, the political purpose of the flight was to, "emphasize the closeness of Soviet-Czechoslovakia cooperation and the USSR recognition of Czechoslovakia as a sovereign equal of the USSR within the Warsaw alliance."[5] Both the host Russian government and the Russian supported Czech government of Gustav Husak needed this symbolic flight to shore up legitimacy given the controversial nature of the Soviet 1968 military invasion of Czechoslovakia.[6] After Remek's flight, additional Warsaw pact guest cosmonauts flew from the nations of Poland, East Germany, Bulgaria, Hungary, and Romania.[7] The *Inter-Kosmos* program became a tool to demonstrate solidarity with fraternal communist nations outside of the Eastern bloc. As testament to this goal, the Soviets flew Vietnam's Colonel Pham Tuan in July 1980, the world's first Asian astronaut, as well as Cuban Colonel Arnaldo Tamayo in September of 1980, the world's first astronaut of African heritage.[8] In later years, as the *Inter-Kosmos* program expanded to include the *Mir*

Figure 42: Crew of *Soyuz* 38 with Colonel Tamayo

Source: "First Black Man in Space," *Russian Space Agency*, http://www.waterholes.com/~dennette/salyut6.htm,(Accessed 28 April 2011).

[3] Nicholas L. Johnson, *Handbook of Soviet Manned Space Flight*, (San Diego, CA: Univelt, 1980) 252.
[4] David M. Harland, *The Story of Space Station Mir* (Chichester, UK: Praxis, 2005), 65.
[5] Michael Sheehan, *The International Politics of Space* (New York: Routledge, 2007), 57.
[6] Sheehan, *The International Politics of Space,* 60.
[7] Harland, *The Story of Space Station Mir*, 70-102.
[8] Sheehan, *The International Politics of Space,* 60.

space station, the Soviets also flew the world's first Afghani astronaut, Abdul Ahad Mohmand.[9] Mohmand's 1988 flight was an obvious attempt by the Russians to buttress the deteriorating political and military situation caused by the Soviet invasion of Afghanistan.

In a somewhat unusual arrangement, non-communist nations also participated in the *Inter-Kosmos* program for reasons generated by national self-interest. In a move to demonstrate independence from the United States dominated Western alliance, France agreed to a *Salyut* flight in 1981. France's deputy head of the space program justified this decision when he stated, "the Soviet Union is a great space power, which possesses immense technical and scientific possibilities, we are very satisfied with the development of this cooperation, if not for it we would have to substantially reduce our program."[10] The Soviet Union also brokered an *Inter-Kosmos* arrangement with India to fly Indian Squadron Leader Rakesh Sharma to the *Salyut* 7 space station in 1984.[11] From the Soviet perspective, developing a relationship with the most influential state along the Indian Ocean could potentially fracture the unity of global democracies, demonstrate the virtues of Soviet communism to a powerful non-aligned state, and strategically offset the growing influence and relationship between China and Pakistan.[12] For India, the surge of domestic pride and unity generated by laying claim to its own astronaut was tremendously alluring to its own sense of idealist principles. Similar arrangements organized under the expanded G*lavKosmos* program, which featured guest flights on *Salyut* 7 and *Mir* from nations such as Austria, Japan, and the United Kingdom.[13]

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[9] "Abdul Ahad Mohmand: The First Afghan in Space," http://www.afghan-network.net/Culture/afghanastronaut.htm (Accessed 15 March 2011).
[10] Sheehan, *The International Politics of Space,* 61.
[11] Harland, *The Story of Space Station Mir, 122-123.*
[12] Sheehan, *The International Politics of Space,* 61.
[13] Baker, *The Story of Manned Space Stations, 62.*

Hence, flights to Soviet space stations under the *Inter-Kosmos* and *GlavKosmos* programs served the immediate political and economic goals of many nations seeking their own national interests. Space historian James Oberg captured the spirit of this program best when he wrote, "The USSR was seeking more practical gains from its space program, in a sense initiating a new space race, not for honor, or even curiosity, but for wealth and power."[14] The Soviet Union was not alone in investigating the exploitation of space for this purpose. The United States executed Type 1 explorations for sake of national interest as well.

The Promise of Freedom

In the post-Apollo era, NASA conceived dreams of constructing a veritable constellation of space stations. According to a 1969 NASA report to the President entitled "The Post Apollo Space Program: Directions for the Future," a space station was the critical centerpiece to the successful implementation of any future US exploration plan.[15] NASA's exploration proposals to the President ranged in value from $6 to $10 billion in government spending per year; an aggressively optimistic budget plan considering NASA received only $5.25 billion at the height of the Apollo era.[16] The space agency hoped to have at least one 12-person space station orbiting Earth by 1975.[17] Expanded plans called for additional space stations in orbit over the Earth and the

Figure 43: President Ronald Reagan shows a Space Station Freedom model to British Prime Minister Margaret Thatcher

Source: Ronald Reagan Library, http://www.aip.org/history/newsletter/spring2005/reagan.htm, (Accessed 26 April 2011)

[14] Sheehan, *The International Politics of Space,* 62.
[15] US Congress, *World-Wide Space Activities,* 85-503, 95th Cong., 1st sess. 1977.
[16] US Congress, *World-Wide Space Activities, 1977.*
[17] National Aeronautics and Space Administration, *Columbia Accident Investigation Report,* (Washington, DC: NASA, August 2003), 21.

moon featuring crew sizes as high as 100 people.[18] In this original vision, the Space Shuttle's purpose would be to construct and service these stations.

While President Nixon agreed with the spirit of space exploration as proposed by NASA, the cost estimates were far outside what he could realistically propose to Congress given the geo-strategic context. In 1970, President Nixon recommended less funding for NASA in FY71 as compared to FY70 stating, "Space expenditures must take their proper place within a rigorous system of national priorities."[19] Despite President Nixon disapproval of these plans, and the subsequent redesign of the Shuttle to accommodate multiple competing requirements from the civil and defense sectors, these space station goals never completely died within NASA. Hence, following the successful opening flights of the Space Shuttle program, the goal of a permanent American space station resurfaced. This time, however, rather than only appealing to purely idealistic reasons for such a station, NASA administrator James Beggs was careful to develop an argument for an American space station matched to national interests as envisioned by President Ronald Reagan.

On 1 December 1983, Beggs argued to the President and the President's Cabinet Council on Commerce and Trade that a space station, designed from the outset to include contributions from the international community, could rally the political and economic strength of America and its allies.[20] Spin-off technologies from the space station could enhance the capabilities of Reagan's Strategic Defense Initiative as well as counter the technological advantages the Soviets enjoyed from

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[18] National Aeronautics and Space Administration, *Columbia Accident Investigation Board Report*, 21.
[19] US Congress, *World-Wide Space Activities, 1977.*
[20] Launius, *Space Stations*, 120.

their *Salyut* stations.[21] Such efforts would bolster America's overall leadership globally and diminish the strength and influence of the Evil Empire. Reagan became convinced of the tie between a space station and US interests and directly addressed the newly dubbed Space Station Freedom in his 1984 State of the Union Address.

> Tonight, I am directing NASA to develop a permanently manned space station and to do it within a decade. A space station will permit quantum leaps in our research in science, communications, in metals, and in life saving medicines which could only be manufactured in space. We want our friends to help us meet these challenges and share in their benefits. NASA will invite other countries to participate so we can strengthen peace, build prosperity, and expand freedom for all who share our goals.[22]

However, Space Station Freedom never garnered broad political support and funding despite President Reagan's endorsements and Administrator Beggs impassioned plea. Despite the overarching goals of the program, the initiative lacked any compelling geo-strategic imperative that would justify its costs. Program management difficulties and technical challenges resulted in a ballooning of the station's initial price tag from $7 billion to over $30 billion.[23] As a result, Congressional advocacy was difficult to marshal amidst the exploding national debt crisis and lack of an imminent need for a space station.[24] Diplomatically, international support and contributions from the European Space Agency, Canada, and Japan proved unwieldy to manage due to disagreements over requirements, technical strategy, and cultural misunderstandings.[25] Support from the scientific community

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[21] Launius, *Space Stations*, 120.
[22] "President Ronald Reagan 25 January 1984 State of the Union Address," *Federalism and the new Conservatism*
"http://reagan2020.us/speeches/state_of_the_union_1984.asp (Accessed 20 March 2011).
[23] Launius, *Space Stations, 136.*
[24] William E. Burrows, *This New Ocean* (New York: Random House, 1999), 594.
[25] Launius, *Space Stations, 136-137.*

waned as frantic redesigns of the station to manage cost, satisfy multiple disparate customers, and mitigate schedule problems resulted in dramatically reduced research capability.[26] Secretary of Defense Casper Weinberger, one of Space Station Freedom's most vocal critics, lambasted the program from the outset as a political boondoggle with limited utility and extravagant costs.[27]

Ultimately, Space Station Freedom's grandiose vision of championing US national interest through technological, political, and economic harmony went unrealized. Instead, Freedom barely lurched American interest forward by producing approximately 75,000 domestic jobs for an ailing aerospace industry and maintaining lukewarm relationships with partner nations.[28] In the 1992 to 1993 session of Congress, numerous bills, each citing the lack of technical merit and gross cost excesses, called for Space Station Freedom's termination.[29] Ultimately, Space Station Freedom deteriorated and failed on the drawing board after costing the US taxpayer $11 billion.[30] Roger Launius, former NASA chief historian, eulogized the political lesson of Space Station Freedom best when he wrote, "It was a fairly simple undertaking for dictators, emperors, pharaohs, and kings to dictate the plans and means for impressive public monuments. But a modern democratic republic such as the United States has trouble with similar complex tasks."[31]

Nonetheless, the technical, political, and international cooperation lessons learned from the Space Station Freedom project would prove critical to advancing the national interests of the US. The original

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[26] Baker, *Manned Space Stations*, 95.
[27] Launius, *Space Stations,* 121.
[28] Launius, *Space Stations,* 133.
[29] US Congress, *To prohibit the expenditure of funds for certain National Aeronautics and Space Administration programs,* S. 2930, 102nd Cong., 2nd sess. 1992.
[30] Baker, *Manned Space Stations*, 95.
[31] Launius, *Space Stations,* 141.

national strategic aims of Space Station Freedom would resurrect from the ashes as a tool of national interest following tectonic shifts in geo-strategic context beginning in the late 1980s.

Shuttle-*Mir* and ISS as tools for Globalization

In August of 1991, agents loyal to the KGB placed Premier Mikhail Gorbachev under house arrest while he was vacationing in his summer *dacha* (vacation home) in the Crimea.[32] A coup was underway in Moscow to rekindle the scant remnants of the once mighty Soviet system. Old guard communist hardliners, dismayed at the lack of response to the 1989 fall of the Berlin Wall and earlier dismissal of the Warsaw Pact, saw Gorbachev's *Perestroika* (Restructuring) and *Glasnost* (Publicity) agendas as politically, ideologically, and economically threatening.[33] However, the ponderous inertia of backwardness, corruption, obsolescence, and social depravity endemic in the Soviet Union had reached a critical mass no longer sustainable despite the efforts of the coup plotters. The Soviet Union quickly collapsed, stalled deeply in disorder and chaos, and emerged from the wreckage as a weakly bound Commonwealth of Independent States (CIS). These catastrophic and sudden implosions created a tremendous opportunity for both America and the CIS to use human spaceflight as a means to advance political agendas, generate economic benefit, enhance scientific knowledge, and address a menacing new national security problem.

Senior officials from the United States were fearful that the chaotic collapse of the Soviet Union created the environment in which former Soviet rocket engineers and nuclear scientists would be tempted

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[32] Serge Schmemann, "The Soviet Crisis: Gorbachev reportedly Arrested in the Crimea", *New York Times*, 21 August 1991, http://www.nytimes.com/1991/08/21/world/the-soviet-crisis-gorbachev-reportedly-arrested-in-the-crimea.html (Accessed 15 March 2011).
[33] Lewis Siegelbaum, "1985: Perestroika and Glasnost", http://www.soviethistory.org/index.php?page=subject&SubjectID=1985perestroika&Year=1985, *Seventeen Moments in Soviet History* (Accessed 14 March 2011).

to sell hardware and expertise on the black market to the highest bidder.[34] Uncertainty as to the geo-strategic impacts caused by the former Soviet Union's sudden loss of esteem, empire, and military prowess generated even greater calls to carry the newly formed CIS through the early stages of government and ideological transition.[35] A new alliance with former Cold War enemies offered the opportunity for an emerging economic market, cultural exchanges, and technology transfer. From the Russian perspective, the nascent post-Soviet governments of Mikhail Gorbachev and his successor, Boris Yeltsin, needed to shore up legitimacy. Cooperation with the Americans offered the chance to garner lucrative financial agreements, gain international political support, and advance domestic unity goals. Within this context of national interest laid the motivational origins for both nations to cooperate through the Shuttle-*Mir* and International Space Station programs.

On 17 June 1992, Russian President Boris Yeltsin and American President George H.W. Bush issued a document with the unwieldy title of *Agreement between the United States of America and the Russian Federation Concerning Cooperation in the Exploration and Use of Outer Space for Peaceful Purposes*.[36] This agreement formalized a series of missions to *Mir* (Peace) by US astronauts, flights aboard the US Space Shuttle by Russian cosmonauts, and a single joint docking mission between *Mir* and the Shuttle during the 1994 to 1995 timeframe.[37] In 1993, recently sworn in US President William Clinton greatly expanded this original agreement as a centerpiece of his administration's overall strategy to sponsor global peace and cooperation. Under the new

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[34] Burrows, *This New Ocean,* 609.
[35] Burrows, *This New Ocean,* 608.
[36]George C. Nield and Pavel Mikhailovich, *Phase 1 Program Joint Report*, NASA SP-1999-6108, January 1999, 2.
[37] Launius, *Space Stations,* 152.

agreement, the 1992 plan enlarged to include 10 dockings and 5 long duration missions.[38]

Furthermore, flights to *Mir* under this new program formed only the first phase of an ambitious multiyear three-stage process designed to promote long-term strategic cooperation. The guiding vision of this initial stage, Phase One, was to, "create the experience and technical expertise for an International Space Station," by bringing together, "the United States and Russia in a major cooperative and contractual program that takes advantage of both countries' capabilities." [39] Phase Two of this program would incorporate the former Soviet Union's space lift and technological expertise into the design and construction of a newly proposed International Space Station—Space Station Freedom's phoenix.[40] Phase Three envisioned long-term joint American and Russian flight operations aboard the International Space Station along with astronauts from other partner nations.[41]

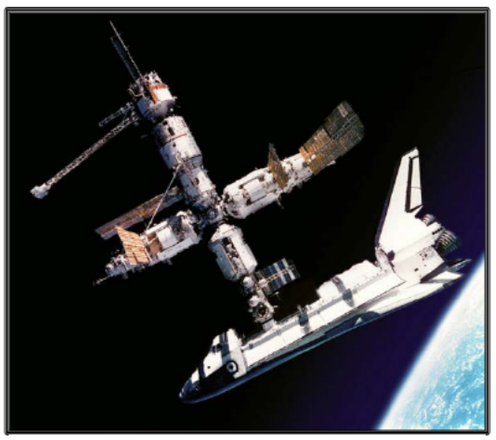

Figure 44: Shuttle Atlantis Docked to Space Station Mir

Source: *NASA*, http://library.thinkquest.org/07aug/00861/issmir.htm , (Accessed 29 April 2011)

Within the United States, many political leaders were wary of this sweeping cooperative partnership with a nation under the grip of tumultuous volatility. A report from the US Congress Office of Technological Assessment cited numerous pitfalls including technical risk, unstable political institutions, instability of the Russian military, economic uncertainty in the Russian markets, crime and corruption

[38] Baker, *Manned Space Stations*, 99.
[39] Nield and Mikhailovich, *Phase 1 Program Joint Report*, 3.
[40] Launius, *Space Stations*, 153.
[41] Launius, *Space Stations*, 153.

within Russian society, and impregnable cultural barriers.[42] Nonetheless, President Clinton's administration viewed the benefits as far outweighing the risks. NASA historian Roger Launius outlined these national interest benefits as,

1. Create a positive image of the United States in an international setting.
2. Encourage greater public interaction between the United States and Russia.
3. Reinforce the perception of American openness to outside nations.
4. Expand the use of space technology as a tool for diplomacy to serve broader US foreign policy goals.
5. Share financial cost and resource burdens while broadening technical expertise.[43]

Nonetheless, the resurrection of Space Station Freedom into the International Space Station, and the resultant commitment to incorporate the Russians into the project remained controversial. In the summer of 1993, the bill sponsoring this agreement passed the US House of Representatives by a 1-vote margin of 215 to 216.[44] Later, the bill survived the Senate by only 19 votes; the slimmest margin of any space station bill voted on by the Senate from 1991 to 1998.[45] The years to come would sorely test the strength and commitment of the United States and Russia in achieving national interest goals using space stations.

During Phase One, Russian cosmonauts and American astronauts suffered many calamities aboard *Mir* that strained US political and public support for the program. While some bright spots existed, such as astronaut Shannon Lucid's record-breaking flight and hero's welcome

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[42] US Congress, Office of Technological Assessment, *US Russian Cooperation in Space*, OTA-ISS-618 (Washington DC: Government Printing Office, April 1995), 11.
[43] Launius, *Space Stations,* 158-159.
[44] "NASA's Space Station Program: Evolution and Current Status", *NASA*, 4 April 2001, http://history.nasa.gov/smith.htm (Accessed 13 March 2011).
[45] "NASA's Space Station Program: Evolution and Current Status", *NASA*, (Accessed 13 March 2011).

from President Clinton upon returning to Earth, the overall American perception of the viability of the program was tepid.[46] Reports of cultural miscommunications, numerous power and computer failures, an on-board fire from a chemical oxygen generator, and near miss with a resupply cargo vehicle served to corrode domestic US support and bring to question the achievability of US national interests.[47] The seminal event that brought these issues to the international forefront was the 1997 disastrous collision between *Mir* and a Progress resupply vehicle that nearly caused a loss of the entire station and an emergency evacuation by the crew.[48]

In the aftermath of the collision, criticisms erupted accusing the Russians of lackadaisical safety protocols and of covering up problems in the hopes of bilking the United States for continued financial support. US Congressional Representative James Sensenbrenner, chairperson of the House Science Committee, decried US leadership to, "reexamine the balance of value versus risk."[49] However, despite calls to end American and Russian cooperation in space, the need to keep the Russian Federation peaceably involved with the international community, US desires to maintain political leverage for arms control, and NASA's wishes to use *Mir* as a platform to learn about long duration spaceflight overrode waves of domestic criticism.[50]

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[46] Baker, *Manned Space Stations*, 106.
[47] Launius, *Space Stations,* 166.
[48] Harland, *The Story of Space Station Mir*, 264-269.
[49] Burrows, *This New Ocean,* 606.
[50] Burrows, *This New Ocean,* 606-609.

Later, the United States would site similar reasons to justify continued commitment in the face of crippling delays, broken promises, and cost overruns caused by the Russians during the construction of the ISS. Specifically, the Russians were responsible for building and launching the critical first module of the ISS known as the Functional Cargo Block or *Zarya* (Sunrise). Without *Zarya*, the remainder of the space station would be in danger of cancelation.[51] Production difficulties within Russia caused *Zarya's* initial cost estimate to US taxpayers to skyrocket from $190 million to $600 million.[52] Subsequently, *Zarya's* launch date slipped by over 7 months causing significant schedule delays to the remainder of the program.[53] Stifling problems of this type between the United States and Russia over the construction of the ISS compounded an already soured relationship from the Shuttle-*Mir* program. Space policy analyst Marcia Smith captured US attitudes towards the Russians during this period when she wrote, "From the beginning, challenges arose with the Russian's participation. Many promises were made by high-ranking government officials that sufficient funding would be provided to fulfill Russian commitments to the ISS. Most were not kept."[54]

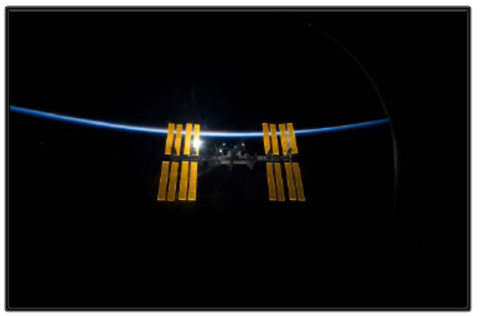

Figure 45: The International Space Station serves as an Instrument of State Soft Power to Promote National Interests

Source: NASA, Abby Cessna, *Universe Today*, 25 January 2010, http://www.universetoday.com/52067/international-space-station/ (Accessed 1 May 2011).

In testimony before Congress, NASA Administrator Dan Goldin acknowledged this same sense of frustration, but also highlighted the

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[51] Launius, *Space Stations,* 183-184.
[52] Launius, *Space Stations,* 185; and Burrows, *This New Ocean,* 607.
[53] "ISS Zarya," *Astronautix*, http://www.astronautix.com/craft/isszarya.htm (Accessed 22 April 2011).
[54] Launius, *Space Stations,* 186.

impact of the space station project to US national interests regardless of cost and delays when he stated,

> This station is a symbol, not of the end of the Cold War, but this Station is a symbol of what nations could do not to build weapons, but to do things on a peaceful basis. And for that reason, I'm not prepared to give up.[55]

Despite the rough political and economic difficulties, US participation with the Russians for both the *Mir* and ISS programs has yielded important benefits. Mainly, cooperation with the Russians fostered US national interests. W Russians, providing flights to the ISS for US astronauts continues to generate economic wealth for the Russian Space Agency and state. For example, in May 2013 NASA paid the Russian Space Agency $424 million for contracted transportation services to the space station.[56] The ISS in particular has become a means with which to merge both the technological and cultural aspects of several nations across the world. The international cooperation required to construct the largest space station ever placed in orbit has served as a tool of overall state foreign policy.

In a relatively recent twist on Type 1 explorations inspired by state interests, space stations now function as a means to generate economic benefit for states under an emerging space tourism industry for private citizens. For instance, the Tokyo Broadcasting System paid the Russian government $28 million to fly a Japanese journalist aboard *Mir* for a week in 1990.[57] Post 2001, the private company Space Adventures brokered several multi-million dollar agreements with the Russian

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[55] US Congress, *US-Russian Cooperation in Human Spaceflight Parts I-V*, 105th Congress, 2nd sess., 1998.

[56] Ledyard King, "Political wrangling pulls NASA in different directions," USA Today, 10 May 2013, http://www.usatoday.com/story/news/politics/2013/05/10/congress-and-administration-at-odds-on-nasa-mission/2151559/ (Accessed 26 May 2013).
[57] Harland, *The Story of Space Station MIR*, 202.

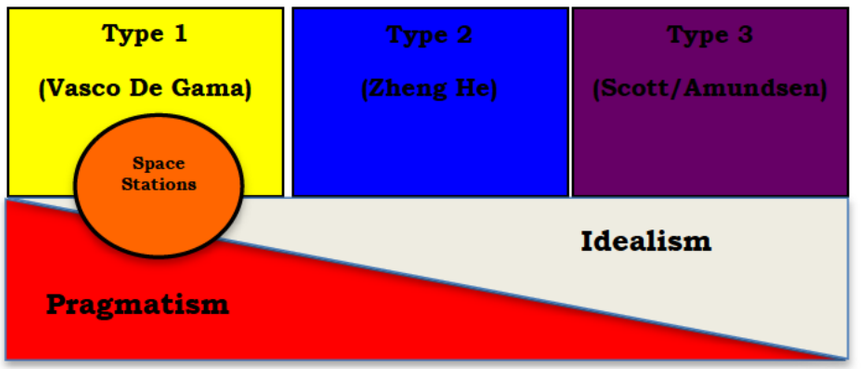
government to fly such notable business professionals and space enthusiasts as Dennis Tito, Mark Shuttleworth, Richard Garriot, and Anousheh Ansari.[58] Recently, the Russian government sold two nearly completed space stations from the legacy *Almaz* military program to the private company Excalibur *Almaz* for potential use as commercial destinations in space.[59] The Russian Space Agency's current prices for private flights to the International Space Station remain exorbitantly high at approximately $40 million per ticket.[60] As a result, the pool of available customers for this luxury will remain extremely small. The long-term viability of this business model, and subsequent potential for the achievement of state goals via the generation of commercial wealth, remains questionable.

Figure 46: American Businessperson Dennis Tito Became the First Private Space Tourist in 2001

Source: *Russian Space Agency*, 28 Apr 2011, http://moonandback.com/2011/04/28/space-tourism-turns-ten%E2%80%AC-miles-obrien-interviews-tito/ (Accessed 18 May 2011).

[58] Anousheh Ansari, *My Dream of Stars* (New York: Palgrave Macmillan, 2010), 96.
[59] http://www.excaliburalmaz.com/ (Accessed 26 April 2011).
[60] Susan Kime, "Up We Go: Space Adventures for the Risk Tolerant Explorer," *Luxist*, 17 December 2010, http://www.luxist.com/2010/12/17/up-we-go-space-adventures-for-the-risk-tolerant-explorer (Accessed 20 May 2011).

Conclusions



The history of *Salyut*, Space Station Freedom, Shuttle-*Mir* and the ISS give a strategist important insights into the viability of Type 1 human spaceflight explorations sparked by national interests. The most significant of these lessons is that human spaceflight can successfully achieve state interest, however the costs to do so can be extreme. The legacies of the Space Station Freedom, Shuttle-*Mir*, and the ISS demonstrate that nations should embark on human spaceflight partnerships for the potential tangible and intangible benefits to state soft power, not for perceived improvements to program cost, schedule timeline, or vehicle performance. In addition, once states are committed to a multi-national space partnership, the diplomatic and political impacts of reneging may prove overwhelming. Hence, national leadership should not enter these partnerships lightly and must have a clear understanding as to the overall strategic ends.

Second, similar to the lessons learned from the analysis of human spaceflight for national security purposes, national interest based human spaceflight cannot remedy Earth problems. For instance, diplomatic partnerships enhanced by guest cosmonaut flights aboard the *Salyut* space station were unable to prevent the collapse of the Soviet Union or were unable to heal wounds between the Soviet Union

and Afghanistan. Hence, human spaceflight for national interests can only be effective if applied under sound and ethical principles of statecraft.

Third, human spaceflight can serve as an inspiration for the development of a science, technology, engineering, and mathematics (STEM). While not by any means the only tool a state can use to encourage STEM, human spaceflight continues to be one of the strongest. Each space station program was justified in part for the stimulus it would bring to the technical base of the nation. Human spaceflight, by default, requires a synergy of various technical disciplines, such as medical sciences, aerospace engineering, physics, astronomy, etc. This institutional collaboration serves as a unique center of excellence to produce innovative capabilities. Spinoffs and breakthroughs from human spaceflight include such leap-ahead technologies as fuel power cells, medical prosthetics, advanced lubricants, and digital computer systems.[61] For the United States, the NASA emblem is the universal symbol of STEM brilliance, as evidenced by the Chilean government's 2010 direct pleas to NASA leadership for help in rescuing 33 trapped miners.[62] The power of the human presence in space to inspire STEM innovation is also apparent in the close intertwining of science and technology education with American space science fiction media and government efforts to popularize human spaceflight to schools through engineering competitions and NASA public relations initiatives. As a sound national scientific base is critical to the strength of a nation in an increasingly technological world, human spaceflight's role in encouraging STEM will continue to be an

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[61] Office of the Chief Technologist, "Spinoff Database," spinoff.nasa.gov/spinoff/database (Accessed 20 December 2012).
[62] Jonathan Franklin, "NASA helping in historic rescue of trapped Chilean miners," *The Washington Post*, 27 Aug 2010, http://www.washingtonpost.com/wp-dyn/content/article/2010/08/27/AR2010082704867.html (Accessed 20 December 2012).

important factor in satisfying national interests under Type 1 explorations.

Last, the persistent allure and adventure of spaceflight offers a unique opportunity for the creation of a private human spaceflight industry. Despite the extreme prices for flights to orbit, the pull of living a lifelong dream, experiencing weightlessness, and viewing the Earth as few have seen it continues to draw a small, but extremely wealthy, stream of enthusiastic adventurers. This opens the potential of using human spaceflight as a means to create economic benefit for a state. Although the dynamics of this industry are still emerging, it provides a tantalizing twist to the achievement of grand strategic goals. This aspect of human spaceflight holds special promise for the creation of innovation in the US space industry and a chance to develop a competitive edge against the rising influence of Chinese human spaceflight.

Chapter 6

HIDDEN DRAGON

Exploration Model and Chinese human spaceflight program: 1953-2011

> *I will live up to the expectations of the motherland and the people, and will try my best to make every part of the mission successful.*
>
> Yang Liwei, PLAAF Lieutenant Colonel, 1st Chinese Taikonaut in Space

The Jiuquan Satellite Launch Center complex sits nestled in the remote reaches of China's Gobi desert. This region, made famous in the past by the Mongol empire and Silk Road trade, became the scene of yet another milestone in Chinese history. On 15 October 2003, loudspeakers broadcast the voice of an excited launch control officer reading the countdown to lift-off.[1] The sound of his voice reverberated across the open plains coloring the anticipation of the moment. As the words *San* (three)…*Er* (two)…*Yi* (one) echoed through the air, a Long March 2F booster thundered off the pad carrying a *Shenzhou* (Sacred Vessel) capsule. *Shenzhou's* occupant, People's Liberation Army Air Force (PLAAF) Lieutenant Colonel Yang Liwei, would

Figure 47: Launch of *Shenzhou* 5

Source: *Chinese Space Agency*, http://www.spacetoday.org/China/ChinaTaikonauts.html, (Accessed 23 April 2011).

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[1] "Chinese Launch Could Signal New Space Race", *CNN*, 14 October 2003, http://www.cnn.com/2003/TECH/space/10/14/space.race/index.html?iref=allsearch (Accessed 20 March 2011).

achieve instant fame as China's first actual space voyager, or taikonaut.[2] With the historic launch of the *Shenzhou* 5 mission, China became only the third nation on Earth to possess a human spaceflight program.

Many analogize China's entry into the high echelon of space faring nations as that of a hidden dragon poised ready to pounce on the mantle of space leadership. As an emerging space power nation, China's current role in human spaceflight is a fascinating unfolding drama of pragmatist and idealist dynamics. As in the historic fifteenth century exploration of Admiral Zheng He, China in the twenty-first century has a re-born geo-strategic imperative and strong competitive risk to assert dominance on the world stage as well as idealistically transform Chinese society. Therefore, in the Exploration Model, China is currently in the midst of a Type 2 exploration campaign. Because of these factors, understanding the saga of Chinese human spaceflight is of special contemporary importance.

Origins

Similar to the United States and Russia, the Chinese human spaceflight exploration program sparked within the crucible of national security concerns. For China, the genesis of these two catalysts for a space program began in 1953 with US President Dwight Eisenhower's threat to end the Korean War using nuclear weapons.[3] Eisenhower's statement generated grave concern within China since the Chinese military was powerless to protect itself or deter the United States from escalating to nuclear violence. Following the war, the regional presence of large foreign military forces within South Korea and Japan fed Chinese qualms over meddling pressure from western powers. The

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[2] Philip Baker, *The Story of Manned Space Stations* (Chichester, UK: Praxis, 2007), 146.
[3] Conrad C. Crane, *American Airpower Strategy in Korea: 1950-1953* (Lawrence, KS: University Press of Kansas, 2000), 164.

1954-1955 Quemoy-Matsu crisis along the China coast only served to accelerate Chinese concerns over US atomic diplomacy and growing Western strategic influence.[4] From the perspective of communist Chinese leadership, China's regional interests and security would always be in jeopardy so long as China did not possess missile-borne nuclear weapons. Without this technology, communist China's strategic goals of demolishing the remnants of the Nationalist government and reunifying Taiwan into China proper would be emasculated.[5] To rectify these security fears, Mao Tse-Tung, China's communist party chairman, turned to the rocketry genius of Tsien Hsue-shen.

Hsue-shen was a Chinese born national who traveled to the US in 1911 on an aeronautical engineering scholarship to the Massachusetts Institute of Technology.[6] While in the US, Hsue-shen achieved great technical prominence as a *protégé* (apprentice) of Theodore Von Karman, research director of solid rocket propulsion at the Jet Propulsion Laboratory, and technical board member of the military team that interrogated Nazi rocket scientist following World War II.[7] However, Hsue-shen's Chinese origins brandished him as a communist threat to the United States under Senator Joseph McCarthy's purges during the early 1950s. With Hsue-shen's deportation, America's

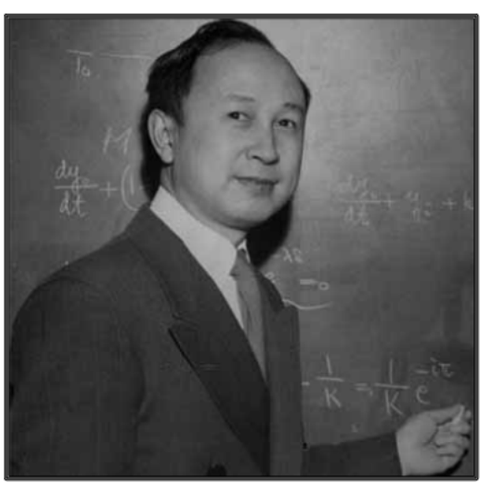

Figure 48: Tsien Hsue-shen, Father of the Chinese Space Program

Source: *MIT Museum*, http://museum.mit.edu/nom150/entries/1505, (Accessed 29 April 2011).

[4] Campbell Craig, *Destroying the Village* (New York: Columbia University Press, 1998), 52.
[5] Xiaoming, Zhang, *Red Wings over the Yalu* (College Station, TX: Texas A&M University Press, 2002), 213.
[6] Erik Seedhouse, *The New Space Race* (Chichester, UK: Praxis, 2010), 14.
[7] Seedhouse, *The New Space Race,* 14.

xenophobia proved a timely strategic bonanza for China. On 8 October 1956, Mao Tse-Tung announced Hsue-shen as the head of the National Defense Ministry's newly formed rocket program.[8] In this capacity, Hsue-shen became the Chinese equivalent of America's Dr. Werner Von Braun or the Soviet Union's Sergei Korolev. Hsue-shen's steadfast, three-decade leadership in the face of astounding domestic challenges proved a critical factor in the achievement of China's national goals.

The primary strategic aim of the Chinese space program in 1956 was to grow regional power projection capability through the development of a medium range intercontinental missile. Soviet aid, in the form of selling the Chinese the Russian version of the captured German V2, was the critical first step of this process.[9] Simultaneous with this effort, China would also develop a nuclear weapon capable of delivery atop one of Hsue-shen's boosters. These national security fear-based goals would expand less than a year later to include the Chinese desire to garner honor.

Inspired by the Soviet's successful launch of *Sputnik* in 1957, Mao ordered his nascent space program to launch a Chinese version of *Sputnik* to commemorate the tenth anniversary of the People's Republic of China in 1959.[10] However, Mao's extravagant visions of spaceflight for pragmatic national security concerns met with the tragic terrestrial realities of his Great Leap Forward program. Mao's "leap," designed to advance China from a backwards agrarian state into an industrial powerhouse, instead caused mass population upheavals, gross misallocation of natural resources, and a death toll estimated between

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[8] Brian Harvey, *China's Space Program: From Conception to Manned Spaceflight* (Chichester, UK: Praxis Publishing, 2004), 22.
[9] "Tsien," *Astronautix*, http://www.astronautix.com/astros/tsien.htm (Accessed 21 March 2011).
[10] Harvey, *China's Space Program,* 25-26.

36 and 45 million.[11] An ideological split with Russia's Premier Nikita Khrushchev in 1960 only added to the Chinese space program's woes by formally severing Soviet technical assistance.[12] Under this context, China's space program failed to achieve any of its original objectives within the proposed timeline and nearly withered to death in the cradle.

Nonetheless, China's weakened space program continued development; albeit at a much less ambitious pace. In 1960, Hsue-shen's defense ministry successfully flew the DF-1; the Chinese version of the German V2.[13] Four years later, in June of 1964, the Chinese successfully launched the indigenously designed DF-2; a rocket capable of striking Japan from Chinese soil.[14] Later that year, China detonated its first nuclear device. These two technologies finally merged on 27 October 1966 when the Chinese conducted an audacious live weapon test of a nuclear-armed DF-2.[15] In doing so, Hsue-shen's rocket technology helped to placate China's fears. The steady Sino advances in space technology also helped pave the way for China's first attempt at Type 2 human spaceflight exploration.

Taikonauts in the Dawn Light

Impressed by the space exploits of the US and Soviet programs, Chairman Mao covertly approved plans for an indigenous Chinese human spaceflight program in March of 1966.[16] From Mao's perspective, flying humans in space was the ultimate stage to achieve superpower status, demonstrate technological acumen, harvest

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[11] Dikötter, Frank. *Mao's Great Famine: The History of China's Most Devastating Catastrophe, 1958-62.* (New York: Walker & Company, 2010), 333.
[12] Harvey, *China's Space Program*, 34.
[13] Iris Chang, *Thread of the Silkworm*, (New York: Basic Books, 1995), 219.
[14] Chang, *Thread of the Silkworm,* 222.
[15] Roger Handberg and Zhen Li, *Chinese Space Policy: A Study in Domestic and International Politics* (New York: Routledge, 2007). 61.
[16] "Shuguang-1," *Astonautix*, http://www.astronautix.com/craft/shuuang1.htm (Accessed 23 March 2011).

international respect, and transform Chinese society. Hence, the geo-strategic context and original documentation of the Chinese indicate that Mao viewed the use of human spaceflight as a Type 2 exploration campaign to fuse idealist principles with urgent pragmatic national security concepts. Mao desperately desired these prestigious outcomes given his nation's political and ideological isolation from both the Soviet Union and the United States.

Similar to the United States and Soviet human spaceflight emphasis on sociological virtues, recruitment for China's future taikonauts heavily reflected idealist cultural values under Mao Tse-Tung. Foremost, prospective candidates needed to have, "consistently expressed correct revolutionary thoughts and have a politically correct family background."[17] The Chinese considered physical and professional skills only once past this political hurdle. In addition, China's human spaceflight selection process, begun several years behind the Americans and the Soviets, benefitted by tailoring the best aspects of both systems to suit China's needs. As a mirror of the Soviet system, China only considered officer fighter pilots from line PLAAF units.[18] As a mirror of the United States system, the Chinese placed special additional emphasis on candidates with advanced technical schooling and special flight experiences above routine flight training time.[19] Interestingly, psychological examinations were not a part of the selection process as the Chinese banned study of psychiatry under Mao's Marxists society.[20] From an initial pool of over 1000 candidates, 19 were ultimately selected on 15 March 1971 to become the initial

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[17]"Shuguang-1," *Astonautix*, http://www.astronautix.com/craft/shuuang1.htm, (Accessed 23 March 2011).
[18] A formal flight test school for the Chinese, in similar fashion to the USAF or USN test pilot school, did not exist in China until 2006. Test Pilot before this point were proficient line PLAAF pilots with minimal additional training for test work.
[19] "Shuguang-1," *Astonautix*, (Accessed 23 March 2011).
[20] "Shuguang-1," *Astonautix*, (Accessed 23 March 2011).

taikonaut cadre of Project 714; China's secret codename for its human spaceflight project.[21] Almost all of the 19 possessed combat flight time with several having earned achievement medals for shooting down US surveillance drones over China during the ongoing Vietnam War.[22]

The Chinese based the blueprint for Project 714's space vehicle upon the American Gemini capsule design. Chinese engineers chose to adapt this design since America's choice of an open civil space program meant that US spacecraft designs were easily attainable. Furthermore, China considered the US Apollo and Russian *Soyuz* capsules as too advanced for their current technological state, but the American Mercury and Russian *Voshkod* capsules as too primitive to garner sufficient honor for the state.[23] Known as the *Shuguang* (Dawn Light), China's capsule would feature a two-person crew and would launch atop a modified Long March 2A booster originally designed for reconnaissance satellites.[24] Once on orbit, the two-person crew would perform scientific research and military missions before de-orbiting and splashing down to a water landing.

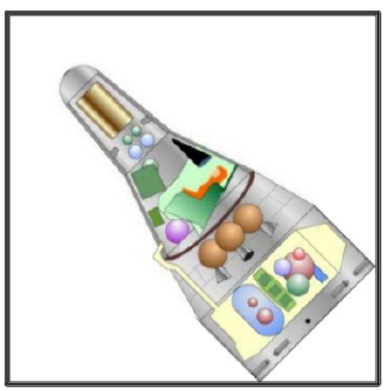

Figure 49: Chinese *Shuguang* Design Based on the US Gemini Capsule

Source: Mark Wade, "Shuguang-1," *Astronautix*, http://www.astronautix.com/craft/shuuang1.htm (Accessed 21 April 2011).

However, Mao's ideological paranoia would again intervene to ensure that neither the *Shuguang* nor any of China's original 19 taikonauts would ever fly. By the mid-1960s, Chairman Mao grew more and more suspicious of supposed capitalist elements within the Chinese

[21] Harvey, *China's Space Program*, 242.
[22] "Shuguang-1," *Astonautix*, (Accessed 23 March 2011).
[23] "Shuguang-1," *Astonautix*, (Accessed 23 March 2011).
[24] "Shuguang-1," *Astonautix*, (Accessed 23 March 2011).

government conspiring to undermine socialist reforms.[25] In May of 1966, Mao instituted the Chinese Cultural Revolution, a program designed to restore Marxist ideals to Chinese society by actively purging non-communists.[26] Mao's purges turned society against itself as suspicion and rampant distrust rotted China from within. Under this program, few within China's government or society were safe from accusations. Mao falsely implicated leaders within China's human spaceflight program as aiding a fictitious coup; imprisonment, torture, and execution became the fate of many space program officials.[27] As a result, Mao's purges devastated not only Chinese society, they also destroyed China's Type 2 human spaceflight program.

In the midst of the Cultural Revolution's ravages, Mao lost his initial zeal for human spaceflight exploration. He blamed failures of Project 714 on the lack of Tsien Hsue-shen's moral courage and deemed spaceflight as irrelevant to national goals.[28] Funding for Project 714 dried up and all personnel assigned to the program returned to their original units by 3 May 1972.[29] As a further sad ending to the program, the Chinese, still envious of the national honor value of a thriving human spaceflight program, staged a mock public affairs release in January of 1980.[30] Photographs detailed Chinese space engineers designing a Skylab like space station and taikonauts training on a Space Shuttle like cockpit. None of these programs actually existed and a goodwill trip to China by US astronauts Gordon Fullerton and Jack Lousma in 1982 confirmed the woefully dilapidated state of Chinese

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[25] Roderick MacFarquhar and Michael Schoenhals, *Mao's Last Revolution* (Cambridge, MA: Harvard, 2006), 7-13.
[26] MacFarquhar and Schoenhals, *Mao's Last Revolution,* 3.
[27]"Shuguang-1," *Astonautix*, (Accessed 23 March 2011).
[28]"Shuguang-1," *Astonautix*, (Accessed 23 March 2011).
[29] Harvey, *China's Space Program*, 243.
[30]"Shuguang-1," *Astonautix*, (Accessed 23 March 2011).

human spaceflight.[31] China's attempts at honor during this era harkened back to the Soviet Union's use of compensatory symbolism to distort reality into rhetoric.

Figure 50: Early *Taikonauts* in a Mock Spaceplane Cockpit

Source: Chinese Space Agency, "Project 921: Chinese Human Spaceflight Program," 27 December 2010, http://sinodefence.wordpress.com/2010/12/27/project-921-chinese-human-spaceflight-programme/,

Rebuilding of China's Spaceflight Technology

Following the death of Mao Tse-Tung in September 1976, China's new Premier, Deng Xiaoping instituted a new direction opposite from Mao's collectivism policies.[32] Xiaoping's Four Modernizations program for agriculture, industry, national defense, and science and technology actively encouraged capitalist overtones and open relations with outside nations.[33] Spaceflight, championed under the modernization banner of science and technology, focused on the development of commercial boosters and satellite technology to improve peasant economic and agricultural development, not on state desires to use human spaceflight for Type 2 exploration.[34] This dedicated focus in the absence of Mao's societal upheavals finally resulted in a respectably robust space lift capability and the development of an advanced family of Long March boosters. Over the following decade, China's use of the Long March to launch commercial satellites payloads for international customers generated millions in profit for the Chinese economy.[35] With China's

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[31] "Project 921," *Air and Space Smithsonian*, 1 November 2002, http://www.airspacemag.com/space-exploration/Project_921.html (Accessed 25 March 2011).
[32] Seedhouse, *The New Space Race*, 15.
[33] Seedhouse, *The New Space Race*, 15.
[34] Roger Handberg and Zhen Li, *Chinese Space Policy: A Study in Domestic and International Politics* (New York: Routledge, 2007), 86.
[35] Handberg and Li, *Chinese Space Policy*, 95.

economic well-being and space lift prowess greatly enhanced, efforts to resurrect Type 2 human spaceflight exploration resurfaced again in 1986.

Taikonauts in Geo-Strategy Reborn

Under Project 863, created in 1986, the Chinese loosely proposed a series of crewed spaceplanes designed to service a scientific space station.[36] Presumably, the Chinese were interested in human spaceflight as a Type 1 exploration tool to address specific national interests related to the then current five-year plan. Although 863 never made it beyond the planning stage, its research became the foundation for China's current human spaceflight program. Designated as Project 921 in 1992, this effort would combine the Long March booster technology developed for China's uninhabited space program with *Soyuz* capsule technology provided by Russia following the collapse of the Soviet Union.[37] From the Russian perspective, selling spaceflight hardware and expertise to the Chinese satisfied Russia's national security financial interests. From the Chinese perspective, leveraging existing technology allowed a quick path to human spaceflight capability.

Unlike the early 1980, an era when China was rebuilding from the ravages of Mao's leadership, the late 1990s and early 2000s were marked by a period of Chinese resurgence on the world stage. Given China's history of domestic unrest and fear of foreign threats, China needed a new campaign to assert itself internationally, while at the same time to unify the populace behind a symbol of transcendence. Much like the voyages of Admiral Zheng He, Chinese human spaceflight could fill this void by serving as a highly visible marker of world superpower

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[36] Harvey, *China's Space Program*, 247.
[37] Harvey, *China's Space Program*, 247.

prestige, spotlighting Chinese cultural ideals, and redefining Chinese citizenry from agrarian isolation to cosmopolitan modernity. Hence, Project 921 became China's re-attempt at Type 2 space exploration. The vehicle China would construct as its modern day equivalent of the *Bao Chuan* was the *Shenzhou* (Sacred Vessel) spacecraft.

Shenzhou, like its *Soyuz* cousin, is comprised of three modules; a forward orbital module, a center reentry capsule, and an aft service module.[38] However, *Shenzhou* is significantly larger in internal volume to better accommodate crews of up to three people for extended missions.[39] Furthermore, the *Shenzhou* orbital module differs from Soyuz in that it features its own power, propulsion, and autonomous flight capability.[40]

Hence, unlike *Soyuz*, *Shenzhou's* orbital compartment is capable of remaining on orbit independent of the re-entry and service modules. Therefore, *Shenzhou's* orbital modules can serve as mini-space station destinations for other *Shenzhou* re-entry and service capsules. These design features reflect China's national aim of quickly developing a permanent presence in space.

Figure 51: *Shenzhou* Spacecraft Cutaway

Source: Chinese Space Agency, *Daily Kos*, 1 March 2009, http://www.dailykos.com/story/2009/3/1/1643/74774/384/703374 (Accessed 27 April 2011).

The *Shenzhou* and Long March booster combination underwent a series of uninhabited test flights from 1999 to 2002.[41] These flights

[38] Seedhouse, *The New Space Race*, 175.
[39] Seedhouse, *The New Space Race*, 175.
[40] Seedhouse, *The New Space Race*, 176.
[41] Seedhouse, *The New Space Race*, 174.

ultimately culminated in *Shenzhou* 5's historic launch in 2003. Taikonaut Liwei remained on orbit for over 21 hours and successfully demonstrated China's ability to launch, track, and recover humans in space.[42] Domestic elation and international praise following *Shenzhou* 5's flight were tremendous. Chinese President Hu Jintao hailed the event as, "an honor for our great motherland, an indicator for the initial victory of the country's first human spaceflight and for a historic step taken by the Chinese people in their endeavor to surmount the peak of the world's science and technology."[43] Like Gagarin, the Chinese government touted Liwei as a paragon of Chinese ideals used him as a symbol to promote domestic agendas and international goodwill.

The Chinese followed up *Shenzhou* 5 with *Shenzhou* 6 in 2005; a two-person taikonaut mission that remained on orbit for 5 days and successfully tested systems aboard both the orbital and descent module.[44] In keeping with the Type 2 theme of Chinese human spaceflight, Wu Bangguo, China's top legislator, touted *Shenzhou* 6's success as, "improving China's international status, national strength, and mobilizing people around the communist party."[45] In 2007, Shenzhou 7 joined the success of Shenzhou 6. This

Figure 52: Spacewalk of *Shenzhou* 7

Source: Chinese Space Agency, "China Completes First Spacewalk," http://english.china.com/zh_cn/news/china/11020307/20080927/15112672.html (Accessed 29 April 2011).

[42] "Yang Liwei: China's First Astronaut," *China.org*, http://www.china.org.cn/china/shenzhouVII_spacewalk/2008-09/12/content_16440252.htm, (Accessed 25 March 2011).
[43] "Status of Shenzhou 5 Spacecraft," *Spaceflight Now*, http://spaceflightnow.com/shenzhou/status.html, (Accessed 23 March 2011).
[44] Seedhouse, *The New Space Race*, 191.
[45] Seedhouse, *The New Space Race*, 190.

flight in particular received worldwide acclaim due to the successful completion of a spacewalk and the first launch of three taikonauts.[46]

On 29 September 2011, China launched *Tiangong*-1 (Heavenly Palace), a 19000 lb, 35 ft long prototype space station designed to orbit Earth for two years.[47] *Tiangong*-1's first inhabitants were the crew of *Shenzhou* 9; launched on 16 June 2012.[48] In addition to being China's first space station mission, *Shenzhou*-9 received special attention as the first flight of China's first female astronaut, PLAAF Major Liu Yuan. Speaking to Chinese President Hu Jintao while on orbit, *Shenzhou*-9 commander Jing Haipeng summed the significance of the mission for China when he radioed, "We are feeling good. Chinese astronauts have their own home in the space now. We are proud of our country."[49]

Figure 53: Crew of *Shenzhou* 9

Source: China Space Agency, http://www.lvz-online.de/files/images/bild_200x150/00000772/chinas-taikonauten_dpacefecf3e341340973908.jpg (Accessed 1 January 2013)

Each of these missions demonstrated a technological generation skip of technology. China's late arrival to human spaceflight has resulted in the ability to leverage existing technology to maximum benefit. However, China's emphasis on preserving face has resulted in a deliberately slow and secretive pace of launch operations. Current plans call for a proposed a moon mission to occur in the years from 2020 to

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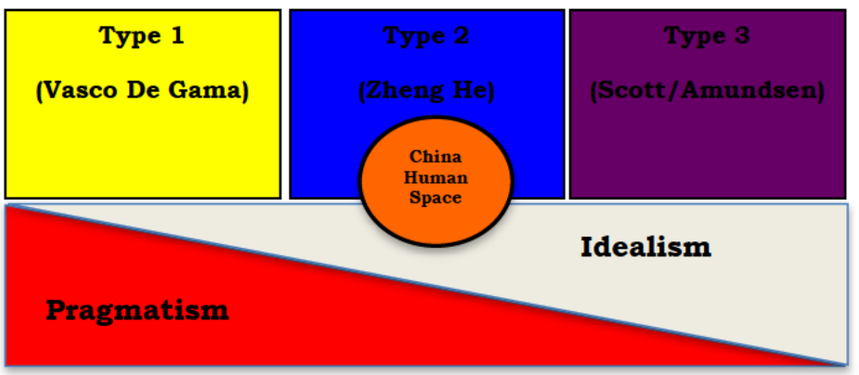
[46] "*Shenzhou* 7," *Astronautix*, http://www.astronautix.com/flights/shezhou7.htm (Accessed 26 March 2011).
[47] Tariq Malik, "China's Tiangong 1 Space Lab," *Space, http://www.space.com/13120-china-tiangong-1-space-laboratory-facts-figures.html (Accessed 23 December 2012).*
[48] "*Shenzhou*-9 Mission Updates," *Spaceflight 101,* http://www.spaceflight101.com/shenzhou-9-mission-updates.html (Accessed 23 December 2012).
[49] "*Shenzhou*-9 Mission Updates," *Spaceflight 101,* (Accessed 23 December 2012).

2025.[50] Given the geo-strategic context and Type 2 strong emphasis China provides to its space program, there is no current reason to believe that China is incapable of achieving this goal.

Conclusions



In similar vein to the early space race programs of the Americans and Soviets, China has embarked on a serious human spaceflight Type 2 exploration agenda intended to satisfy both pragmatist and idealist principles. Understanding the unique history and motivations for China's space program helps to clarify several salient features for an American spacepower strategist.

First, China's human spaceflight efforts advance a larger campaign of Chinese ascendancy on the world stage. Human spaceflight exploration addresses the fear of subjugation to foreign powers, the honor of joining the rank of the world's leading superpowers, and the idealist principles of advancing scientific knowledge and Chinese culture. However, unlike the early space race between the United States and the Soviet Union, there is no indication from the Chinese of a quest to defeat Western style democracy. Nor is there any indication from the Chinese of a military human spaceflight program designed to carry out a doomsday nuclear mission against

[50] Seedhouse, *The New Space Race*, 194.

America. Instead, China's human spaceflight program enhances asymmetric space faring capabilities as a means to increase global competitiveness. For instance, advances made from the *Shenzhou* program and Long March family of boosters provide spin-off technologies, such as advanced space lift and tracking networks, useful for China's space warfare, technological development, and commerce strategies. Hence, China's human spaceflight program, while not an existential fear based threat to America, represents an enduring important challenge to US national interests in terms of space leadership and overall global strength. Strategist must not dismiss the rising competition from China.

Second, China's objective of landing taikonauts on the moon is a direct affront to America's crowning spaceflight achievement. However, trying to re-create a race to the moon with the Chinese reminiscent of the 1960s competition between the United States and the Soviet Union would be a poor strategic move for America. In many regards, accepting such a challenge would be akin to the Soviet's ill-conceived decision to accept the moon race against the US in the 1960s in spite of larger strategic factors that cautioned otherwise. If the United States won this competition against the Chinese, it would only prove that America can commit a tremendous amount of resources to replicate an act first accomplished in 1969. If the United States lost this competition, the prestige ceded to China by the United States would be the death knell of America's human spaceflight program. In either scenario, the United States plays directly into the strategic trap laid by China; either way the United States loses.

Instead, America should pursue its own objectives, such as flights beyond cis-lunar space, that the Chinese are either incapable of or uninterested in. With regard to the moon, the United States should not return to the lunar surface as an end unto itself in order to best the

Chinese space program. Rather, return flights to the moon should be part of a larger exploration plan to explore Mars. The moon, due to its relative proximity to the Earth, should serve as a surrogate for the development of techniques, procedures, and technologies necessary for long duration planetary exploration. Rather than sample return missions or opportunities to "plant the flag," flights to the moon should be a test-bed for how to live and thrive off Earth as part of a larger strategic goal.

In this manner, China's flights to the moon could be a boon for their own purposes, while the United States could continue to set the bar for space exploration leadership by reaching destinations far beyond the moon. The details of this approach expand in greater detail in the strategy for the future of human spaceflight described in the following chapter.

Chapter 7

WHERE DO WE GO…WHERE DO WE GO NOW?

Crafting a strategy to leverage human spaceflight capabilities for the future of US spacepower leadership

> *My position is that it is high time for a calm debate on more fundamental questions. Does human spaceflight continue to serve a compelling cultural purpose and/or our national interest? Or does human spaceflight simply have a life of its own, without a pragmatic objective that is remotely commensurate with its costs? Or, indeed, is human spaceflight now obsolete?*
>
> James Alfred Van Allen, 2004

The hallmark of sound strategy is harmonization across the spectrum of ends, ways, and means. In this definition, ends refer to the overarching objectives of a nation, ways refer to the methods used to accomplish strategic ends, and means define the available resources to support ways. Decoupling any one of these three elements from the others will result in a ruinous strategy that wastes precious resources or commits futile ways towards the achievement of ill-defined ends. Furthermore, successful strategy is both an art and a science; it requires a skillful blend of pragmatism and intuitive creativity. Too much emphasis on rote pragmatism results in dull, unimaginative, and relatively inflexible solutions to vexing and adaptive problems. On the contrary, a hyper-focus on creativity can result in fantasy-like solutions with no basis in reality. A strategist must walk a fine line of discernment to bridge the gap between the real and the possible.

With respect to America's human spaceflight program, sound strategy is especially vital given the traditionally long development times and cost of historical space programs. Furthermore, implementation

requires engendering steady popular backing; a task not easy given the fractious nature of the American political system. The failure of several recent human spaceflight exploration national initiatives highlights the difficulty of achieving effective US space strategy. Achieving clarity of purpose and consistency of message are the fundamental keys to success. Therefore, lighting a clear pathway to link strategy ends, ways, means with implementation support begins by understanding the current impact of strategic culture on the future of human spaceflight exploration.

Human Spaceflight and Strategic Cultures

The information presented in chapters 3 through 5 provides insight into America's strategic culture. Prime among these insights is that America's strategic culture links inextricably with its uniquely placid geographic location on Earth. Protected on the east and west by thousands of miles of open-ocean and bordered on the north and south by the benign nations of Canada and Mexico, America's development has been uncommonly sheltered from existential threats. This inherent geographic protection from adversarial powers, coupled with abundant natural resources, underwrote America's meteoric rise to global influence in the late nineteenth and twentieth centuries. This rapid gain of power and wealth also contributed to the concept of American Exceptionalism; the notion that the US is the global champion of democratic ideals and has a special responsibility to provide world leadership. America's large expanse of domestic territory and historical use of new vehicles and tools to tame unknown frontiers means that the US holds a general sense of optimism for the future and faith in a technological fix to any problem. However, America's geographic protection has also fostered a lackadaisical attitude towards emerging threats that do not pose an immediate threat to US interests. As discussed in chapter 3, America's slow adoption of the airplane in the

early twentieth century compared to European nations is a prime example of this attitude. This lack of urgency and complacency has become especially prevalent in the mid-twentieth to twenty-first centuries given America's longstanding position as a global superpower. For instance, the US was slow to recognize the Soviet space program until the shock of *Sputnik* threatened America's sense of superiority and invulnerability. In similar fashion, the US recognized the twenty-first century rise of China only after China acquired military capabilities capable of threatening US interests. However, as evidenced by the amazing technological accomplishments of the Apollo program, once the US realizes a significant threat, America has an incredible depth of resources to address the challenge. As a result, the US has a strategic culture characterized by fascination with technology, possession of amazing creative might, and an optimistic interest in the future. However, America also has a fundamental lack of urgency to advance these ideals in the absence of an imminent threat. This strategic culture helps to explain the results of several national surveys conducted during the 2007 to 2008 timeframe in which 68% of Americans believed in the benefits of the space program yet 51% ranked the space program as the number one federal program to cut.[1] Strategists must account for this unique dual-nature aspect of American strategic culture.

Due to significant differences in history and geography, China's strategic culture is substantially different from that of the US. China borders several rival nations, such as Vietnam, Japan, and Mongolia, which have been the source of multiple brutal clashes and ruthless invasions. The greatest manifestation of this fear of foreign invasion was the Ming dynasty construction and modernization of the Great Wall

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[1] Derek Warren and Bridget Conway, *Future of US Human Spaceflight…Background and Issues* (New York: Nova Science, 2010), 194-195.

during the fifteenth century. In addition, China's reversion to Confucian isolationism in the fifteenth century hobbled its development and resulted in nearly 500 years of delayed progress and subjugation to European powers. Internally, a violent civil war for national power between the communists and the nationalists, Mao's Cultural Revolution and Great Leap Forward, and China's on-going complications with Tibetan separatist and Taiwanese independence supporters highlight China's struggles for domestic security amongst broad ethnic and political groups. For China, the result of these factors is a strategic culture characterized by extreme sensitivity to emerging threats, a desperate need to cobble multiple internal groups into a single national identity, and an eagerness to claim its place as a great nation in the world in order to intimidate future foreign threats into submission. As detailed in chapter 6, China views its current human spaceflight program much as it once viewed the voyages of Admiral Zheng He; primarily as an entryway to garnering international respect, but also as a powerful symbol of modernity and unity for its desperate populace. As an emerging, vice established, global power, China's motives for pursuing human spaceflight are especially compelling given the geo-strategic context of the twenty-first century. Consequently, China's strategic culture will likely view any spaceflight program accomplishments by other powers, namely the US, as inherently provocative and will re-double efforts towards the achievement of its own national honor goals as a means to embarrass and pressure rivals.

Russia, much like China, has an expansive geography and a history of major foreign invasions across its borders. Like China, Russia features a broadly diverse conglomeration of ethnic and political groups that are difficult to coalesce into a single identity. As such, Russia's strategic culture is one of paranoia to foreign and domestic threats. The blatant appeals of Stalin and Khrushchev to compensatory symbolism

and internal purges were endemic of this culture. Unlike China, the 1991 collapse of the Soviet Union was a major source of worldwide humiliation to the strength of Soviet strategic culture. Russia, in the aftermath of the collapse, is currently within the midst of a struggle to regain much of its former international respect and power. One of the few means to accomplish this goal is to leverage the achievements and capabilities of its human spaceflight program. The space accomplishments of the old Soviet regime, such as *Sputnik*, Gagarin, *Salyut*, and *Mir*, still serve as validation of the potential for Russia to reclaim its former glory. The US dependence upon Russia for flights to the International Space Station further re-enforces this strategic cultural imperative. Strategist must be aware that this aspect of Russia's strategic culture will drive near fanatical political/economic efforts by the Soviet government to keep the US human spaceflight program dependent upon the Russian space agency.

For the United States, these aspects of strategic culture across the three major human spaceflight powers have important significance for the future of American spacepower. Specifically, understanding the lens of strategic culture is important for assessing America's view of risk with respect to the potential catalyst spark of future human spaceflight exploration.

The Catalyst Spark

Currently, the necessary conditions for state sponsored human spaceflight exploration are still satisfied. Humankind sufficiently understands how to conduct expeditions to low Earth orbit and the reach of available technology and resources is sufficient. Better still; voyages beyond cis-lunar space are within the reach of current technology. The key elements of a human expedition to Mars, such as propulsion, bio-medical life support, navigation, communications, etc.

are not beyond the scope of the current state of the art. Hence, the frontier of space still beckons and humankind has the means within its grasp to explore and exploit the domain. However, this alone is not sufficient.

The Exploration Model predicts that a pragmatist based imminent national security concern must be the catalyst of state sponsored exploration. Over the past 50 years of human spaceflight, this spark has originated within the crucible of international relations between the United States and the Soviet Union/Russia. For the United States, the Mercury, Gemini, Apollo, Space Shuttle, and International Space Station programs all trace their lineage to the pragmatic factors of fear, interests, and honor with respect to America's struggle for global dominance over communism. Looking forward to the next 50 years of human spaceflight, however, the geo-strategic context is not as clear-cut.

Unlike the heyday of the Cold War, no existential threat against the United States or the American way of life currently exists. Amongst modern space faring nations, there is no ideological struggle for supremacy. Nor are there any known economic or militarily significant strategic choke points in space that human spaceflight can address. Additionally space science has not discovered extra-terrestrial life, intelligent or otherwise, that fundamentally re-shapes humankind's place in the universe. No known global extinction-level event, such as that posed by the imminent impact of an asteroid or comet, currently menaces life on Earth. Even if astronomers were to discover an impending impact, the timeline of the evolving crisis would need to be sufficiently long enough to allow human spaceflight to make a meaningful contribution either through collision avoidance or small-scale evacuation. Given the fact that NASA currently estimates it detects approximately 1% of the estimated 500,000 near Earth objects

believed to be 30 meters or greater in diameter, it is unlikely that many of these hazards would be discovered, let alone discovered in sufficient time.[2]

For example, astronomers detected asteroid 2012 DA14's close pass inside the Earth's geostationary satellite belt on 15 February 2013 less than one year earlier.[3] On the same date, the 500-kiloton blast generated from the re-entry of an unrelated 15 meter diameter meteorite over Chelyabinsk Russia caused over 1000 injuries and caught the world completely by surprise.[4] Perhaps these two events will eventually spawn renewed long-term commitment towards planetary defense. However, at the time of this writing, there is no indication of a state leadership sea change shift in attitudes towards this mission other than temporary alarm and media sound bite rhetoric. To be quite blunt, events like the Chelyabinsk asteroid happen too infrequently, have not killed or hurt enough people, and have not caused sufficient damage for the US to take serious notice. Perhaps this attitude would have been different if the Chelyabinsk asteroid were instead the Chicago asteroid.

Figure 54: February 2013 Meteorite over Chelyabinsk Russia

Source: Tariq Malik, "Russian Meteor Blast Bigger than Thought : NASA," http://news discovery.com/space/asteroids-meteors-meteorites/russian-meteor-blast-bigger-nasa-130217.htm (Accessed 1 March 2013)

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[2] Erika Bolstad, "Near Earth objects: Exciting Day…Like a Shooting Gallery," *Maine Sunday Telegram*, 16 February 2013, http://www.pressherald.com/news/nationworld/in-focus-near-earth-objects_2013-02-16.html (Accessed 1 March 2013).

[3] Phil Plait, "No, Asteroid 2012 DA14 will not hit us next year," *Discover Magazine*, 4 March 2012, http://blogs.discovermagazine.com/badastronomy/2012/03/04/no-asteroid-2012-da14-will-not-hit-us-next-year/#.UTPs1KWf9QQ (Accessed 1 March 2013).

[4] Tariq Malik, "Russian Meteor Blast Bigger Than Thought: NASA," *Discovery Magazine*, 17 February 2013, http://news.discovery.com/space/asteroids-meteors-meteorites/russian-meteor-blast-bigger-nasa-130217.htm (Accessed 1 March 2013).

Fortunately, the US has not had to face disasters of this nature as of yet. Hence, the pragmatic based sparks of fear and interest are not current motivators for human spaceflight exploration.

Consequently, the only remaining spark that can initiate the future of American human spaceflight exploration is an appeal to national honor. Much as Great Britain invested heavily in ocean scientific exploration during the nineteenth century to preserve its reputation as the foremost naval power of the world, so to must the United States pursue human spaceflight exploration as a means to maintain its standing as the space leader of the world. However, as indicated by the background research used to construct the Exploration Model, appeals to national honor spur exploration campaigns only in the presence of credible state level competition for resources or accolades. In this regard, the rise of China's space program is the only viable challenger to the United States.

To date, however, the Chinese have only re-accomplished achievements in space that the United States performed in the 1960s. Furthermore, outside of official state rhetoric, the Chinese have not produced any hardware or mission plans that indicate an imminent landing on the moon; an accomplishment engrained in the world's consciousness as something singularly American. Because of these factors, the accomplishments of the Chinese human spaceflight program to date have not yet crossed the threshold to trigger American national honor concerns beyond the peripheral competitive risk level. This attitude reflects strategically in the low federal resourcing priority given to NASA's budget and the lackadaisical political support human spaceflight has received in recent years.

Using the Exploration Model, the current geo-strategic context indicates Type 3 exploration as the best construct for the future success

of America's human spaceflight program. The danger of this approach for the United States, however, is that in the absence of a clearly articulated strategic vision, the Chinese will likely eclipse American national honor in space long before the United States can marshal efforts to maintain spacepower leadership. A loss to the Chinese of this magnitude would shake confidence in the viability of America's aerospace industry as well as the global perception of the United States as the superpower leader of audacious and innovative space exploration campaigns. Fortunately, the United States possesses an emerging and unique opportunity to execute Type 3 exploration as a means to remain globally competitive. The baseline strength of this approach is rooted in the unprecedented new opportunity to build a strong human spaceflight minded society.

The Strategic Need for a Human Spaceflight Mindedness

In the late 1800's, sea power theorist Alfred Thayer Mahan speculated about the impact of a sea-minded society upon a nation's overall sea power. From Mahan's point of view, the presence of a strong merchant marine fleet boosted a strong Navy.[5] The merchant marine provided a valuable revenue stream for a nation in peacetime and created a class of individuals in society with vital sea faring skills in the event of war. In turn, the navy protected merchant marine sea commerce from the threat of enemy fleets; thereby bulwarking national power by providing assured access to markets while denying the same luxury to the enemy. Mahan believed that this synergy between government and commercial capabilities in a nation blessed with natural access to the world's oceans created a strong sea-minded society. A sea-minded populace in turn provided the political mandate

[5] Alfred Thayer Mahan, *Mahan on Naval Strategy* (Annapolis, MD: Naval Institute Press, 1991), 27-29.

for the state to invest resources in sea power and explore the world's oceans as a path towards world prominence.

Likewise, airpower theorists Billy Mitchell and Julio Douhet described an air-minded society in which a commercial aviation industry supported a robust military aerospace capability.[6] Societies willing to develop the technology and infrastructure required to support mass commercial air travel and advanced aeronautical systems would also stand to reap tremendous wartime advantages. Like Mahan, both Douhet and Mitchell envisioned a harmony between government and commercial industry as the symbiotic link needed to produce an air-minded society; one that was willing to exploit airpower for its unique abilities as opposed to viewing it solely as an extension of land or sea power.

From the view of these theorists, an air or sea-minded society was the key ingredient to enable states to join the most prominent nations of the world. It extended the reach of human presence and opportunity into domains previously inaccessible. With regard to space, however, a complex nexus of factors make exploitation and access significantly different from the utilization of terrestrial based domains.

For example, the deep gravity well of Earth is a staggering technological barrier requiring energies several orders of magnitude beyond that required to embark on an ocean voyage, travel across the land, or take to the skies. To achieve and sustain the bottom reaches of low Earth orbit alone requires vehicles with the ability to accelerate from the launch pad to a velocity of at least 17,500 nautical miles per hour. Furthermore, the environment of space renders even the most exotic

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[6] William Mitchell, *Winged Defense: The Development and Possibilities of Modern Air Power – Economic and Military* (Tuscaloosa, AL: University of Alabama Press, 2005), 98; and Giulio Douhet, *The Command of the Air* (Tuscaloosa, AL: University of Alabama Press, 2009), 123-124.

Earth climates as tame by comparison. Blistering temperature swings of several hundred degrees, intense and deadly radiation, absence of liquid water, food, or air, and the debilitating biological effects of continuous free-fall, makes the space environment supremely hostile to life and machines. Last, orbital spaceflight require a highly integrated global network of ground support facilities for control and communications purposes. Flights beyond cis-lunar space greatly complicate all of these factors.

Hence, for a state to develop space faring capabilities requires an intricate harmony across the continuum of facilities, industry, hardware, economy, education, geography, culture, intellectual climate, and populace support far in excess of the air or sea domains.[7] Few nations have these skills and resources in sufficient quantity to join the highest echelon of spacepower states; those that possess an indigenous human spaceflight program.

As of January 2013, only 530 people from 38 nations have ever flown in space.[8] This number is a paltry figure compared to the millions who travel through the air and sea domains every year. For humans, space travel remains the exclusive domain of an extraordinarily small subset of military test pilots, scientists, and engineers who possess incredible academic gifts, health, physical fitness, and uncommon luck. Hence, the development of a space-minded society with a long-term commitment to state human exploration missions becomes complicated in part due to the lack of direct experiential contact by the general populace as a whole. In contravention to the science fiction promises of mass human spaceflight, the science reality of the common citizen is to

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[7] James Oberg, *Space Power Theory* (Colorado Springs, CO: US Air Force Academy) 44.
[8] "List of Space Travelers by Name," *Wikipedia,* http://en.wikipedia.org/wiki/List_of_space_travelers_by_name (Accessed 1 January 2013).

experience space vicariously only through the stories of astronauts or the electronic sensors of robotic systems.

From this perspective, broadening the direct experience of spaceflight to a wider populace becomes an important tool to construct a strong space-minded society supportive of human spaceflight's role in achieving US grand strategic objectives. Building support in this manner is critical for garnering increased public and political support; a key center of gravity in an idealist based Type 3 class of human spaceflight exploration. The emerging partnership between government and commercial human spaceflight is the only avenue for this broadening experience to occur. Because of America's unique business climate and strategic cultural approach to creativity, individuality, innovation, and risk as described in chapter 3, the United States is the best nation on Earth for nurturing this type of relationship to its full potential. Hence, the partnership between commercial and government human spaceflight is a unique strength the United States must leverage in pursuing the ends, ways, and means of America's future spacepower strategy in today's challenging fiscal and political climate.

The Ends of US Spacepower Strategy

American spacepower ends, as defined by the 2010 US National Space Policy (NSP), include the invigoration of domestic competitive industries, expansion of international cooperation, strengthening of space operations stability and resilience, pursuit of human and robotic initiatives, and the enhancement of space-based Earth and solar observations.[9] The NSP further directs all US departments and agencies to strengthen US leadership both domestically and internationally in space and space related science, technology, and industrial efforts.[10]

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[9] National Space Policy, 28 June 2010, 4.
[10] National Space Policy, 5-6.

The 2011 National Security Space Strategy (NSSS), military complement to the 2010 NSP, strongly reaffirms these goals, but also acknowledges the need to deter space aggression and protect capabilities in a degraded space domain.[11]

Overall, the broad and defuse nature of these American spacepower goals is confounding. For example, none of these goals point to a defined or quantifiable end state. It is impossible to define exactly when US capabilities have matured to the point deterring space aggression. How much expansion of international cooperation in space is enough? To what extent should the United States pursue robotic versus human spaceflight? Furthermore, while NASA is directed by the White House to send astronauts to an asteroid, there is no linkage as to how this particular mission is necessary for fulfilling the goal of sending humans to Mars and beyond; the penultimate mission objective of NASA across the previous 50 years of spaceflight.[12] There is also no discussion as to an effective build-up approach using lunar surface exploration as part of a larger Mars exploration mission plan. Last, neither the NSP nor the NSSS are truly a "strategy" since both are silent on priorities and about channeling ways and means towards the accomplishment of ends. As a result, many have rightly criticized these documents for being too vague and political to provide much meaning.

However, the NSP and NSSS do provide several bright spots. First, the White House specifically directs the NASA administrator to begin crewed missions beyond the moon by 2025 and flights to orbit Mars by the mid-2030s.[13] This is at least an acknowledgement, albeit muted, that the White House views interplanetary flight as the ultimate goal in much the same way as NASA. Second, the NSP and NSSS

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[11] National Space Security Strategy, January 2011, 1.
[12] National Space Policy, 11.
[13] National Space Policy, 11.

formally highlight America's ongoing commitment to the pursuit of space advantage irrespective of context or prevailing conditions. This approach allows for flexibility in ways and means and focuses on long-term adherence to a desired set of behaviors as opposed to transient short-term wins or loses. Third, these documents officially acknowledge the importance of a holistic approach using the abilities of both government and commercial industry to meet future challenges in space. Hence, while these strategic documents concerning American spacepower are far from perfect, they do provide at least a basic conceptual framework for the future direction of overall US spacepower.

Within this framework, NASA's Type 3 exploration directive to journey beyond cis-lunar space holds the promise of garnering great prestige for the United States and achieving profound significance for all of humankind. Human spaceflight exploration, given the conclusions drawn from this research, is especially suited to this idealist-based niche role in US grand strategy. However, also in accordance with Type 3 exploration, it is unlikely the US government will lavishly resource this type of endeavor given the current geo-strategic context, political atmosphere of austerity, strategic culture, and lack of competitive risk from state challengers. This lack of a sufficiency condition for exploration has plagued previous NASA human spaceflight efforts.

For example, the pragmatic and idealistic reasons for human space exploration to destinations such as the Moon and Mars featured in the now defunct 2004 Vision for Space Exploration (VSE) as well as its predecessor, the 1989 Space Exploration Initiative (SEI). As stated within the VSE,

> The space missions in this plan require advanced systems and capabilities that will accelerate the development of many critical technologies, including power, computing, nanotechnology, biotechnology, communications, networking, robotics, and materials. These technologies underpin and advance the U.S. economy and help ensure national security…The accomplishments of U.S. space explorers are also a particularly potent symbol of American democracy, a reminder of what the human spirit can achieve in a free society.[14]

Specific to the exploration of Mars, the SEI argued,

> Mars has undergone a complicated geologic evolution. Its surface consists of gigantic canyons, huge volcanoes, gorges carved by running water, vast regions of sand dunes, and a polar ice cap. Understanding the periodic changes in climate that have occurred on Mars will help us understand the Earth's climate and predict its future behavior, a topic vital to the survival of life on Earth.[15]

Both strategies emphasized expeditions to the Moon, not as an Apollo-style short-term visit to raise the flag and conduct limited science, but as a surrogate to test the equipment and techniques necessary for long duration stays on the surface of Mars. In a sentiment echoed by Lieutenant General Ferguson's argument to Congress in the 1960s concerning the Manned Orbiting Laboratory, both strategies emphasized the need for humans to explore the space frontier due to the innate on-the-spot flexibility and adaptability a human presence affords over pre-programmed machines or tele-presence. Unlike the 2010 NSP and the 2011 NSSS, the VSE and SEI strategies focused on prioritization of efforts, featured clearly defined objectives, proposed timelines for important milestone accomplishments, and emphasized a

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[14] National Aeronautics and Space Administration, *Vision for Space Exploration* (Washington, DC: NASA, February 2004), 21.
[15] The Synthesis Group, *America at the Threshold: America's Space Exploration Initiative* (Washington, DC: May 1991), 4.

harmony across ends, ways, and means. Nonetheless, both strategies ultimately failed mainly because of a lack of a geo-strategic catalyst for space exploration. While the necessary conditions for exploration were present, no sufficiency condition existed in either 1989 or 2004 to compel broad support for audacious human space exploration in spite of the well-articulated visions contained in both documents and the grandiose manner in which two sitting Presidents introduced these strategies to the public. As indicated by the research conducted for this study, the occurrence of a pragmatic catalyst for exploration is beyond the control of any exploration organization; it is an external geo-strategic event that states use exploration as a means with which to address. Under the Exploration Model, state exploration campaigns within the context described above run the risk of languishing in obscurity with minimal resource support. This characteristic continues today, except without the benefit of an official exploration strategy like the VSE or SEI. NASA's recent budget history reflects evidence of this phenomenon.

To support the agency's new goals in the NSP, the President proposed increasing NASA's budget by a total of $6 Billion across FY11 to FY15.[16] However, Congressional funding for NASA remained flat at approximately $18 Billion, roughly 3% of non-defense discretionary spending.[17] For comparison, the Type 2 space exploration of the Apollo era commanded an FY11 adjusted budget allocation of approximately $33 Billion or nearly 19% of non-defense discretionary spending.[18] NASA's flat budget, currently projected to remain unchanged as far as FY17, is woefully insufficient for managing an increasingly expensive and broadly aging infrastructure, supporting NASA's full portfolio of missions, and building the next generation of human spaceflight

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[16] National Research Council, *NASA's Strategic Direction and the Need for Consensus* (Washington, DC: National Academies Press, 2012), 12.
[17] National Research Council, *NASA's Strategic Direction,* 20.
[18] National Research Council, *NASA's Strategic Direction,* 20.

exploration boosters and vehicles.[19] This stark reality highlights the need for a major renaissance of America's human spaceflight program in order to achieve success in the future.

For instance, under the current austere paradigm, focused technology development will be difficult resulting in extended timelines for goal accomplishment and an increased risk of waning public and political support. This negative trend will only continue to worsen so long as misinformation and mass confusion continue to reign nationally concerning America's ultimate goal for human spaceflight and the technology development path necessary for NASA to accomplish this purpose. Unfortunately, the NSP and NSSS do not provide focus and clarity in this regard.

To remedy this confusion in the strategic end state, the White House must help prioritize human spaceflight as NASA's hallmark contribution to US grand strategy, strategically message both the pragmatic and idealistic based justifications for human spaceflight, and facilitate NASA's internal restructuring and streamlining to achieve this end in an extremely limited fiscal environment. While NASA cannot create a geo-strategic imperative to spark its own exploration campaign, the US government can aid NASA in the stewardship of its allocated resources as well as help in the acquisition of this nation's next generation of spacecraft. By enacting new proposed legislation that extends the term of office of the NASA administrator to ten years and reforms the traditional Planning, Programming, Budgeting, and Execution (PPBE) process, NASA can achieve greater long-term funding stability. Changes of this nature, not unprecedented in the history of the federal government, are vitally important for the execution of NASA's current exploration mission as they help to decouple long-term

[19] National Research Council, *NASA's Strategic Direction,* 20.

objectives and resourcing from the dangers of short-term political expediency. In the event a stronger geo-strategic catalyst materializes in the future, such as an impending Chinese moon landing or asteroid impact, clearly establishing the ends of spacepower strategy in this manner better positions the US to manage steady progress towards the attainment of its own grand strategic goals. These insights are critical when evaluating the unique strategic ways available for human spaceflight exploration to support the ends of America's space strategy.

The Ways of US Spacepower Strategy

A government centric approach has dominated the first 50 years of human spaceflight. The United States, Russia, and China all adopted this model due to the tremendous uncertainties involved in spaceflight, national industrialization effort required to marshal resources and talent, and geo-strategic implications of success or failure. In essence, all three nations adopted a technocratic approach as a means of directing resources towards the accomplishment of Type 2 and Type 1 explorations. However, this approach has also created an extensive bureaucratic infrastructure that is both expensive to maintain and relatively inflexible to rapid changes. Space programs under this architecture generally tend to rapidly balloon in cost and quickly exceed initial schedule estimates. Hence, according to the Exploration Model's warnings of strategic overreach, space programs tend to become ripe political targets for cancellation. Human spaceflight programs, due to their added complexity, weight, and safety requirements over uninhabited vehicles, are especially susceptible to these adverse programmatic characteristics. According to a 2012 National Research Council report, a chief contributor to this problem is unsteady funding of multi-year projects at the NASA programmatic level making project

execution impossible to perform.[20] As a result, the previous 20 years of human spaceflight development, from the vaunted National Aerospace Plane to the Constellation program under the Vision for Space Exploration, resemble a graveyard of lost dreams.

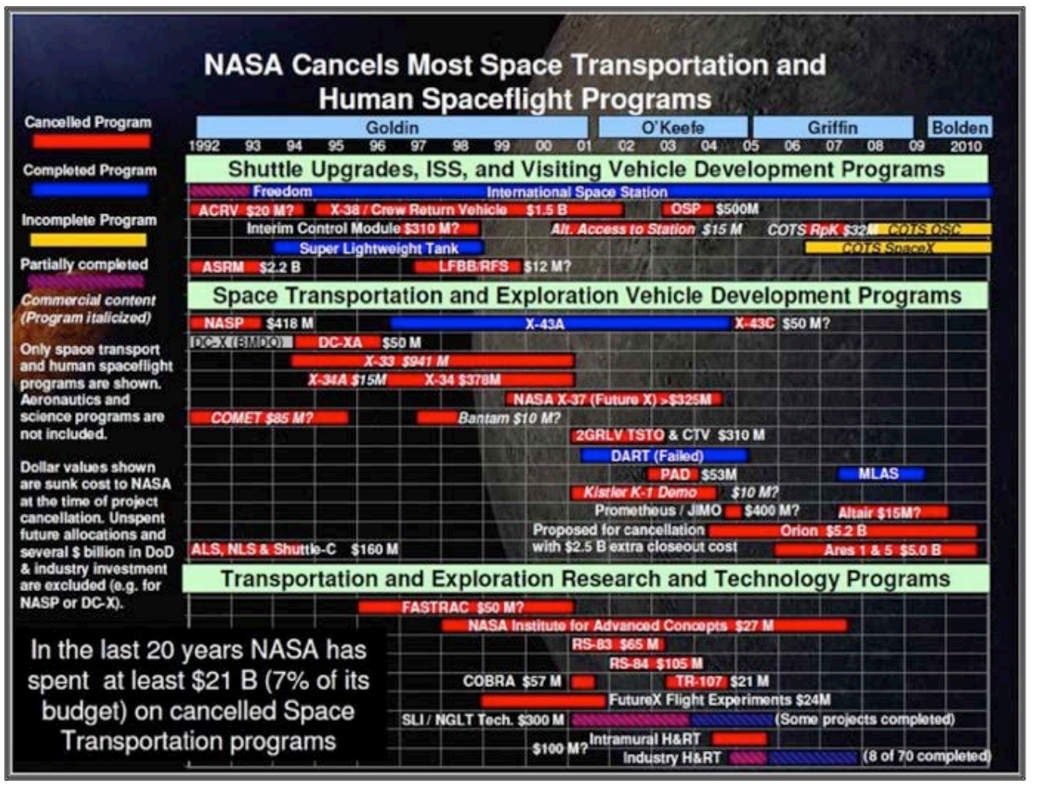

Figure 55: Cancelled Space Transportation and Human Spaceflight Programs of the Previous 20 Years

Source: Dr. Scott Pace, "A Review of NASA s Exploration Program in Transition: Issues for Congress and Industry," *Space Policy Institute*, 30 March 2011, http://www.gwu.edu/~spi/assets/docs/Pace_House_Testimony_033011.pdf (Accessed 28 April 2011).

The historical miasma associated with securing long-term political support, combined with today's context of dwindling state financial resources, has made the government centric approach to Type 3 human spaceflight exploration untenable. As per the 2010 NASA Authorization Act, the retirement of the Space Shuttle in the summer of 2011 bookended America's 50 years of exclusive government control and

[20] National Research Council, *NASA's Strategic Direction,* 3-4.

direction of human spaceflight.[21] Instead, the United States must now turn to a hybrid approach that seeks to use commercial and government human spaceflight to accomplish America's spacepower objectives.[22] In this model, government human spaceflight efforts will focus on accomplishing Type 3 deep space exploration missions beyond cis-lunar space, while commercial companies focus on missions to low Earth orbit.[23] Analysis of this new strategic approach to human spaceflight provides important insights into potential opportunities and pitfalls for the future of American spacepower.

Changing the strategic way of human spaceflight from a purely government system to a government and commercial hybrid partnership unfetters public and private sector organizations to focus on missions ideally suited to their unique structure and purpose. In accordance with objectives described in the 2010 NSP, 2004 VSE, 1989 SEI, and the 2009 Augustine Commission presidential review of human spaceflight, deep space Type 3 exploration missions are important as they help to expand the frontiers of science and engineering, encourage international participation and cooperation, and open new opportunities for resource exploitation.[24] However, these missions typically require complex operations associated with great risk and long epochs of technological development. These strategically important missions are uniquely suited for government as the great unknowns and high costs associated with them are tremendous disincentives for commercial spaceflight companies.[25] In turn, commercial companies will compliment government efforts by focusing on relatively low risk, short development

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[21] *2010 NASA Authorization Act*, S.3729, 111th Cong., 2nd sess., (2010), 6.
[22] *2010 NASA Authorization Act*, S.3729, 7.
[23] Review of US Human Spaceflight Plans Committee, *Seeking a Human Spaceflight Program Worthy of a Great Nation (2010),* 16.
[24] Review of US Human Spaceflight Plans Committee, *Seeking a Human Spaceflight Program,* 9; and National Space Strategy, 28 June 2010, 4.
[25] William Pomerantz (Virgin Galactic Vice President for Special Projects), interview by the author, 25 March 2011.

time missions using simple and mature technology.[26] This frees precious government resources for more advanced spacepower uses, creates a viable new industry for space, and unleashes commercial competition as a means to create incremental technology advancements at greater speed and reduced cost than equivalent government efforts. Direct citizen participation in space flight will also foster a society of space-mindedness eager to support Type 3 human spaceflight exploration.

In essence, the United States is in the process of relinquishing a pure technocratic approach to human spaceflight, implemented since the administration of President John F. Kennedy, and supplanting it with a middle ground approach between pure technocracy and *laissez-faire* style technological development. Given the current lack of a compelling geo-strategic imperative to funnel human spaceflight efforts towards the transcendent goal of interplanetary travel, this shift in the ways of space strategy is appropriate and of potentially great benefit for the United States. As demonstrated by the early Russian and American approaches to aeronautical development during the Golden Age of aviation, this emerging model of human spaceflight can unleash a surge of entrepreneurial innovation and greatly expand the spectrum of spacepower capabilities. As related by Phil McAlister, acting director of NASA's Commercial Human Spaceflight Division, several distinguishing contemporary factors enhance the potential for the success of this way of strategy over the previous era's graveyard of lost dreams.

First, the retirement of the Space Shuttle and cancellation of the follow on Constellation space program has effectively eliminated the mainspring of America's human spaceflight capability for many years.[27] The ominously large gap of time between the final Space Shuttle mission

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[26] Pomerantz, interview, 25 March 2011.
[27] Phil McAlister (NASA HQ), interview by the author, 22 March 2011.

and first flight of the next generation US government spacecraft has created unprecedented incentive and opportunity for favorable government policy changes and demand for commercial low Earth orbit vehicles. Second, the US government's decision to extend funding and support for the ISS until at least 2020 closes the business case for commercial providers by providing, for the first time, a destination in space for the delivery of cargo and crew.[28] Third, 50 years of government spaceflight in low Earth orbit has produced a tremendous trove of skill and technology.[29] This greatly reduces the technical risk for commercial companies since they can leverage this experience to emulate spaceflight technology that has been in existence since the 1960s. Last, the recent emergence of space tourism and increasing demand for low cost, reliable, and routine access to space by foreign nations, the scientific community, and private businesses has created a broad customer base for commercial human spaceflight companies instead of a NASA monopsony.[30] This reduces overall business risk as it provides several revenue streams and multiple paths for development in the event demand from the US government slackens.

Additionally, the recent establishment of aerospace achievement financial prizes and incentives has accelerated the push for commercial human spaceflight innovation.

Figure 56: Members of the Mojave Aerospace Ventures Team Celebrate after the Ansari X PRIZE Winning Flight

Source: Jim Sugar, "Flying High-Private Space Flight," *National Geographic*, http://science.nationalgeographic.com/science/space/space-exploration/flying-high.html (Accessed 30 April 2011).

[28] McAlister, interview, 22 March 2011.
[29] McAlister, interview, 22 March 2011.
[30] McAlister, interview, 22 March 2011.

These prizes mirror similar efforts conducted by both the government and wealthy private citizens during the Golden Age of aviation to spur aerospace achievement. In 1919 for example, New York hotel magnate Raymond Orteig established a $25,000 prize for the first non-stop aircraft flight between New York and Paris.[31] Charles Lindbergh, a young and unknown airmail pilot at the time, would claim this prize eight years later and catapult to aviation fame with his legendary 33½-hour solo flight across the Atlantic Ocean.[32] Nearly eight decades later, the Orteig prize became the inspiration for entrepreneur Peter Diamandis's X PRIZE; a $10 million award for the first non-government team to launch a three-person capable sub orbital spacecraft above 100 kilometers twice within a two week time period.[33] This prize, renamed in 2004 as the Ansari X PRIZE after a multi-million dollar donation from entrepreneurs Anousheh and Amir Ansari, awarded in October of 2004 to the Mojave Aerospace Ventures' SpaceShipOne project.[34] This team, a joint-project between Burt Rutan's Scaled Composites company and Microsoft Co-Founder Paul Allen, heralded a new era in human spaceflight in much the same manner that Lindbergh's flight revolutionized air travel.[35] In similar vein, NASA's financial incentives to private industry for milestones achievements under the ISS Commercial Crew Development program offer additional viability to the success of commercial human spaceflight. As stated by William Pomerantz, formerly of the Google Lunar X PRIZE foundation, the recent creation of highly publicized competitions for honor and financial awards have brought great legitimacy to commercial human spaceflight.[36] These

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[31] "Raymond Orteig - $25,000 prize," Charles Lindbergh: An American Aviator, http://www.charleslindbergh.com/plane/orteig.asp, (Accessed 20 March 2011).
[32] "Raymond Orteig - $25,000 prize," Charles Lindbergh, (Accessed 20 March 2011).
[33] Anousheh Ansari, *My Dream of Stars* (New York: Palgrave Macmillan, 2010), 76.
[34] Ansari, *My Dream of Stars*, 94.
[35] Ansari, *My Dream of Stars*, 94.
[36] Pomerantz, interview, 25 March 2011.

endeavors also serve as a catalyst to bring together wealthy and willing investors with talented aerospace engineering teams.[37]

However, unlike the pioneers of the Golden Age of aviation, contemporary human spaceflight entrepreneurs face a gauntlet of legal and liability obstacles equally as challenging as any technical barrier. In today's litigious society, defining the rules of legal liability for accidents involving commercial human spaceflight vehicles continues to be a major challenge for this emerging industry.[38] In addition, legacy principles under the 2010 US State Department's International Traffic in Arms Regulations (ITAR) hobble the competitive efforts of American commercial human spaceflight companies to recruit top talent and harness the best materials. The provisions of ITAR, originally designed as a means to control the export and import of defense related articles, broadly classifies any American technology relating to space launch vehicles as a non-releasable state controlled item.[39] The strict interpretation of this regulation originates from a February 1996 incident in which the US State Department charged Loral Systems with violating the Arms Export Control Act.[40] US government officials alleged an illegal transfer of technology occurred once western engineers aided Chinese accident investigators following the failed launch of a Long March booster carrying a US telecommunications satellite.[41] As identified in the NSP, stemming the flow of advanced space technology to unauthorized parties will continue to be a top priority of the US

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[37] Pomerantz, interview, 25 March 2011.
[38] Frank Culbertson and Bob Richards (Orbital Sciences), interview by the author, 21 March 2011.
[39] US State Department, *International Traffic in Arms Regulations* (Washington, DC, 1 April 2010), Part 121.
[40] *US National Security and Commercial Concerns with the People's Republic of China,* 105-851, 105th Cong., 2nd sess., (2010), 96.
[41] *US National Security and Commercial Concerns with the People's Republic of China*, (2010), 96.

government.[42] However, given the sweeping changes in commercial human spaceflight that have occurred in intervening 15 years since the Long March incident, a review of ITAR policy is warranted to streamline and clarify which classes of space technology are truly advanced and national security controlled, and which are commonplace and sharable with foreign nationals.

Despite these pitfalls, a hybrid government and commercial approach as a way of accomplishing the objectives of US spacepower strategy is a viable approach given today's contextual factors. This approach appeals to the unique abilities of American entrepreneurship and strengths of government human spaceflight. In this context, the utility of human spaceflight in building the link between strategic ends and ways is important when evaluating the available means proposed by government and commercial human spaceflight actors.

The Means of US Spacepower Strategy

The next 50 years of human spaceflight will look dramatically different from the first 50 years. NASA's current plan for exploration beyond cis-lunar space envisions the use of Lockheed Martin's Orion capsule under the Multi-Purpose Crew Vehicle (MPCV) program.[43] The current test plan details the uninhabited MPCV launch of Exploration Mission 1 (EM-1) in 2017 atop the first iteration of the Space Launch System (SLS); a 318 ft tall heavy booster capable of lifting 70 metric tons to low earth orbit.[44] If successful, EM-2 would follow in 2021 with an inhabited mission to circumnavigate the moon.[45] Much of the surrounding architecture for the MPCV program, such as the design and

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[42] National Space Strategy, 8.
[43] Randy Sweet, Eric Hogan, and Vanessa Aponte (Lockheed Martin), interview conducted by the author, 30 March 2011.
[44] Chris Bergin, "Exploration Mission 1: SLS and Orion mission to the Moon outlined," *NASA Spaceflight*, http://www.nasaspaceflight.com/2012/02/exploration-mission-1-sls-orion-debut-mission-moon-outlined/ (Accessed 1 February 2013).
[45] Bergin, "Exploration Mission 1, (Accessed 1 February 2013).

integration of a long-term crew habitation module, Orion capsule service module, and crew surface landers has yet to be determined given the spiral development nature of the program. Because of this, proposed destinations for the MPCV remain vague. Nonetheless, the development of the MPCV and SLS combination represents America's best and only hope for future government led deep space exploration.

Figure 57: Artist Conception of the Multi-Purpose Crew Vehicle Orion and Space Launch System Booster

Source: "Orion," *Lockheed Martin*, 22 March 2010, http://www.isciencetimes.com/data/images/full/2012/10/31/2746.jpg.

Ceding low earth orbit to commercial companies will allow NASA to direct what limited federal resources it receives towards supporting the development of the MPCV and the SLS. Nonetheless, the birth of a hybrid government and commercial system will prove a daunting challenge. Fortunately, a slew of proposals from leading actors within the government and commercial human spaceflight industry offer a glimpse into the future means of American spacepower leadership. In similar vein to the Golden Age of aviation, US government agencies, from the DOD to NASA, can utilize the most promising of these technologies via a fast adopter, rather than state directed approach.

Current efforts by commercial and government human spaceflight organizations are seeking to advance space technologies across the spectrums of space lift, deep spaceflight, orbital, and suborbital operations. These advances organize under three new initiatives; the Commercial Orbital Transportation Services (COTS), Commercial Crew Integrated Capability/Commercial Crew Development (CCiCap/CCDev), and non-government commercial spaceflight. Progress along these

fronts will greatly advance state objectives proposed in the 2010 NSP and 2011 NSSS at a fraction of the cost of the old technocratic paradigm.

For example, the goal of COTS is to provide routine and low cost commercial cargo resupply service to the International Space Station. NASA established Phase 1 of COTS in 2006 and invested $800 million through 2012 to fund development efforts by SpaceX and Rocketplane-Kistler.[46] Phase 2 of COTS began in 2012 with awarded contracts to Orbital Sciences and SpaceX.[47] In similar fashion, the objective of CCiCap/CCDev is to create, "a new way of delivering cargo – and eventually crew – to low-Earth orbit (LEO) and the International Space Station (ISS)."[48] In this manner, NASA hopes to spur innovation in crew transportation and spark the growth of a private orbital space industry. CCICap/CCDev began with a NASA investment of $50 million to seven aerospace companies using funds from the 2009 American Recovery and Reinvestment Act.[49] In April 2011, the second round of this program began with awards of $22 million to Blue Origin, $92.3 million to Boeing, $75 million to SpaceX, and $80 million to Sierra Nevada.[50] Finally, several private aerospace organizations hope to push the state of the art in on-demand suborbital access for research/development and tourism, as well as advance the cause of building a space faring society. Organizations, such the Federal Aviation Administration Office of Commercial Space Transportation and Commercial Spaceflight Federation, foster the growth, promotion, and regulation of this nascent

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[46] "Commercial Cargo and Crew," *NASA*, http://www.nasa.gov/offices/c3po/about/c3po.html (Accessed 20 May 2013).
[47] "Commercial Cargo and Crew," *NASA*, html (Accessed 20 May 2013).
[48] "Commercial Crew & Cargo," *NASA*, http://www.nasa.gov/offices/c3po/partners/ccdev_info.html (Accessed 21 May 2013).
[49] "Commercial Crew & Cargo (CCDev)," *NASA*, http://www.nasa.gov/offices/c3po/partners/ccdev_info.html (Accessed 21 May 2013).
[49] "Commercial Crew & Cargo (CCDev)," (Accessed 20 May 2013).
[50] "Commercial Crew & Cargo (CCDev)," (Accessed 20 May 2013).

industry.[51] Between COTS, CCiCap/CCDev, and the commercial human spaceflight industry, several actors have become serious technical contenders worthy of state attention.

Figure 58: Falcon 9 with Prototype Dragon Capsule Launches from Cape Canaveral on 8 December 2010

Source: Gary I Roth, *MSNBC* http://www.msnbc.msn.com/id/37989073/ns/technology_and_science-falcon_9?q=Falcon%209 8 December 2010 (Accessed 29 April 2011).

Under COTS and CCiCap/CCDev, SpaceX, a company founded in June 2002 by PayPal billionaire Elon Musk, is the current leader.[52] A cornerstone of SpaceX's success is their development of the Merlin engine; a liquid fueled engine that serves as the propulsion source for SpaceX's family of boosters.[53] Using a Falcon 1 booster powered by a single Merlin engine in the first stage, SpaceX achieved notoriety on 28 September 2008 by becoming the first private organization to launch a liquid fueled rocket into orbit.[54] The success of the Falcon 1 series of flights paved the way for Falcon 9; a significantly larger booster powered by nine Merlin engines in the first stage.[55] In July of 2010, Falcon 9 successfully achieved orbit on its maiden launch. Subsequently, Falcon 9 became the booster for the historic launch, orbit, and recovery of SpaceX's prototype Dragon capsule in December of 2010.[56]

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[51] "Office of Commercial Space Transportation," *FAA*, http://www.faa.gov/about/office_org/headquarters_offices/ast/ (Accessed 20 May 2013); and *Commercial Spaceflight Federation*, http://www.commercialspaceflight.org/ (Accessed 21 May 2013).
[52] Jamie Hadden, Ken Bowersox, Garret Reisman (SpaceX), interview conducted by the author, 27 March 2011.
[53] Hadden, Bowersox, Reisman, interview, 27 March 2011.
[54] Hadden, Bowersox, Reisman, interview, 27 March 2011.
[55] Hadden, Bowersox, Reisman, interview, 27 March 2011.
[56] Hadden, Bowersox, Reisman, interview, 27 March 2011.

Upon achieving full operational status, the Dragon capsule will feature two variants, one for cargo and one for crew, and will initially serve as a vehicle to service the ISS under NASA's CCDev program.[57] Three Dragon cargo capsules have already delivered supplies to the ISS in May 2012, October of 2012, and March of 2013.[58] However, the company envisions using the Dragon and Falcon 9 combination to perform a variety of future missions including space tourism, DOD support, and service to commercial space stations.[59] Future proposals call for the development of Falcon 9 Heavy, a booster capable of lifting twice the payload of Delta IV Heavy, and a vertical landing version of the Dragon capsule, a spacecraft capable of delivery of cargo and crew to virtually any destination on the planet.[60] With respect to US spacepower ends and ways, the addition of the Falcon family of boosters provides a greater variety of space-lift launch options, fuels competition with the Delta and Atlas series of rockets, and helps to drive down launch cost to orbit. As encouraging proof of this potential, a 2011 NASA report to Congress estimates that it would cost the US government an estimated $1.7 to $4 billion to perform the same mission with a Falcon 9 equivalent program that cost SpaceX $390 million.[61]

Figure 59: Dragon Capsule at the ISS

Source: NASA, http://spaceflight1.nasa.gov/gallery/images/station/crew-31/html/iss031e079326.html (Accessed 2 January 2013)

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[57] Hadden, Bowersox, Reisman, interview, 27 March 2011.
[58] "Dragon Overview", *SpaceX*, http://www.spacex.com/dragon.php (Accessed 2 March 2013).
[59] Hadden, Bowersox, Reisman, interview, 27 March 2011.
[60] Hadden, Bowersox, Reisman, interview, 27 March 2011.
[61] Frank Morring Jr., "Panelist: SpaceX Costs Offer Hope for NASA," *Aviation Week and Space Technology*, 20 May 2011, http://www.aviationweek.com/aw/generic/story_channel.jsp?channel=space&id=news/asd/2011/05/19/01.xml&headline=Panelist:%20SpaceX%20Costs%20Offer%20Hope%20For%20NASA (Accessed 21 May 2011).

The tremendous gulf in costs, derived using a NASA-Air Force cost parametric tool that references a database of 130 historical government spaceflight projects, owes to the differences in overhead and bureaucracy between government and commercial industry.[62]

Also under CCiCap/CCDev, the Sierra Nevada Corporation is developing the Dream Chaser spacecraft. Dream Chaser's design originates from the NASA HL-20 lifting body craft from the 1990s; itself a loose reproduction of the Soviet Bor-4 spaceplane from the 1960s.[63] Sierra Nevada chose this approach to leverage the extensive library of data already produced during the test programs of these vehicles. Dream Chaser features seating for up to seven crewmembers and will launch atop an Atlas V booster.[64] The lifting body design allows greater cross range maneuverability and lower g-loading during reentry and landing than a capsule. At the time of this writing, Sierra Nevada is planning operational flights of the Dream Chaser in the 2016-2017 timeframe.[65] Sierra Nevada Corporation continues to make steady progress towards this goal as evidenced by their successful captive carry

Figure 60: Sierra Nevada Dream Chaser

Source: http://www.thedenverchannel.com/news/images-dream-chaser-spotted-in-colo-

[62] Frank Morring Jr., "Panelist: SpaceX Costs Offer Hope for NASA," *Aviation Week and Space Technology*, 20 May 2011, http://www.aviationweek.com/aw/generic/story_channel.jsp?channel=space&id=news/asd/2011/05/19/01.xml&headline=Panelist:%20SpaceX%20Costs%20Offer%20Hope%20For%20NASA (Accessed 21 May 2011); and Dallas Bienhoff (Boeing In-Space and Surface Systems), interview by the author, 21 March 2011.

[63] "Commercial Crew and Cargo (Sierra Nevada), *NASA*, http://www.nasa.gov/offices/c3po/partners/sierranevada/index.html (Accessed 20 May 2013).

[64] "Space Exploration Systems," *Sierra Nevada Corporation*, http://www.sncspace.com/ss_space_exploration.php (Accessed 20 May 2013).

[65] "Dream Chaser: Sierra Nevada's Design for Spaceflight," *Space*, http://www.space.com/19552-dream-chaser.html (Accessed 19 May 2013).

flight test in May of 2012 as well as their ongoing spring 2013 drop flight tests at the NASA Dryden Flight Research facility.[66]

Within the area of commercial human spaceflight, the combined team of Scaled Composites and Virgin Galactic lead suborbital efforts. Their suborbital spaceplane, SpaceShipTwo, is a significantly larger, robust, and capable operational progenitor of the original SpaceShipOne.[67] In addition to serving space tourism passengers, SpaceShipTwo will perform scientific and bio-medical microgravity research missions.[68] Of particular interest to the DOD, WhiteKnightTwo, the carrier platform for SpaceShipTwo, can potentially fulfill a niche strategic market as an atmospheric launch platform for micro satellite and small spaceplanes.[69] In this capacity, WhiteKnightTwo can support the military's long-standing quest for a truly operationally responsive space lift capacity.

Figure 61: WhiteKnightTwo Carrier Aircraft with SpaceShipTwo Spaceplane

Source: Mark Greenberg, Virgin Galactic s VSS Enterprise Makes First Captive Carry Flight," *SpacePlex*, 22 March 2010, http://spaceplex.com/2010/03/22/virgin-galactics-vss-enterprise-makes-first-captive-carry-flight/ (Accessed 30 April 2011).

From the perspective of Scaled Composites and Virgin Galactic, providing cheap, reliable, and routine access to space for all citizens will create the foundations of a truly space-minded and space faring

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[66] Chris Bergin, "SNC Captive Carry test sees Dream Chaser take flight," *NASA Spaceflight*, 29 May 2012, http://www.nasaspaceflight.com/2012/05/snc-captive-carry-test-dream-chaser-take-flight/ (Accessed 19 May 2013).
[67] Mark Stucky and Matt Stinemetze (Scaled Composites), interview conducted by the author, 26 March 2011.
[68] Stucky and Stinemetze, interview, 26 March 2011.
[69] Stucky and Stinemetze, interview, 26 March 2011.

society.[70] Fielding SpaceShipTwo will serve as a foundational step in the long-term development of innovative suborbital spaceflight technologies, such as point-to-point global travel. As of the time of this writing, flight-testing continues on SpaceShipTwo; the most notable achievement being its first rocket powered flight in April of 2013. Virgin Galactic currently expects the first commercial flight to occur on Christmas Day in 2013.[71]

Figure 62: SpaceShipTwo's 1st Rocket Powered Flight

Source: http://www.wired.com/images_blogs/autopia/2013/04/ss2-first-supersonic-flight-telescope-image-660x434.jpg

Another leader in the suborbital commercial market is XCOR, maker of a family of lightweight and efficient liquid fueled rocket engines as well as the EZ-Racer and X-Racer rocket powered aircraft. XCOR is developing the Lynx; a spaceplane that will perform similar space tourism, microgravity research, and microsatellite launch booster suborbital missions as SpaceShipTwo.[72] However, rather than air launching from a carrier platform, Lynx will self- launch from a runway like a conventional aircraft.[73] This concept of operations greatly reduces complexity, improves operational flexibility, and provides niche military application.

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[70] Stucky and Stinemetze, interview, 26 March 2011.
[71] "Branson: Virgin Galactic launch Christmas Day," *ABQ Journal*, 22 May 2013, http://www.abqjournal.com/main/2013/05/22/biz/branson-virgin-galactic-launch-christmas-day.html (Accessed 22 May 2013).
[72] Aleta Jackson and Eric Anderson(XCOR), interview conducted by the author, 26 March 2011.
[73] Jackson and Anderson, interview, 26 March 2011.

XCOR envisions a unique spot responsive military surveillance mission for the Lynx.[74] Under a concept known as virtual persistence, a Lynx spaceplane outfitted with an electro-optical package, electronic collections sensors, or radar-mapping pod could use its runway launch flexibility and suborbital apogee to provide flexible strategic surveillance of hostile nations with non-permissive air environments. In this capacity, Lynx could add to the available options for national security surveillance spaceflight. In addition, Lynx's launch and reentry profile mimics that of ballistic missiles. Because of this capability, Lynx can also serve as a surrogate target for rapid testing and fielding of ballistic missile defense radar tracking and targeting systems.[75]

Figure 63: XCOR's Lynx Spaceplane Concept with External Payload Fairing
Source, *XCOR*, http://www.xcor com, (Accessed 1 May 2011).

Finally, Bigelow Aerospace, another leader in the commercial human spaceflight industry, aims to develop a series of private space stations to serve as destinations for military, civil, international government, research, and private customers. The company founder, hotel entrepreneur Robert Bigelow, envisions orbiting inflatable habitats constructed from Vectran; a

Figure 64: Genesis I Inflatable Habitat

Source: http://www.bigelowaerospace.com/

[74] Rick Searfoss (XCOR), interview conducted by the author, 26 March 2011.
[75] Jackson and Anderson, interview, 26 March 2011.

material twice as strong as Kevlar.[76] The advantages provided by inflatable modules, vice rigid structures, include lighter weight, expanded volume, and increased damage resistance to meteorite strikes. In 2006, Bigelow Aerospace successfully orbited a subscale 410 ft^3 inflatable module, christened Genesis I, aboard a Russian provided Dnepr booster.[77] Genesis II, a nearly identical module to Genesis I except with improved instrumentation, flew successfully to low Earth orbit in 2007.[78]

Realizing the potential of inflatable habitats, NASA entered into a $17.8 million contract to fly a developmental Bigelow Expandable Activity Module (BEAM) to the ISS in 2015.[79] The BEAM will test radiation exposure, structural integrity, leak rate, and temperature shifts across a notional two-year mission.[80] The results of this test will help Bigelow Aerospace develop and field a series of for-hire stations composed of the BA330; a 11,700 ft^3 inflatable module.[81] Over the long term, the company hopes to orbit the 74,200

Figure 65: BA330 Mockups

Source: http://www.space.com/19234-inflatable-space-stations-bigelow-aerospace-photos.html

[76] Paul Marks, "NASA turned on by blow-up space stations," *New Scientist*, 3 March 2010, http://www.newscientist.com/article/dn18607-nasa-turned-on-by-blowup-space-stations.html (Accessed 20 May 2013).
[77] "Genesis I," *Bigelow Aerospace*, http://www.bigelowaerospace.com/genesis-1.php (Accessed 21 May 2013).
[78] "Genesis II," *Bigelow Aerospace*, http://www.bigelowaerospace.com/genesis-2.php (Accessed 20 May 2013).
[79] "NASA to test Bigelow Expandable Module on Space Station," *NASA,* http://www.nasa.gov/mission_pages/station/news/beam_feature.html (Accessed 22 May 2013).
[80]"NASA to test Bigelow Expandable Module on Space Station," (Accessed 22 May 2013).
[81] "BA 330," *Bigelow Aerospace*, http://www.bigelowaerospace.com/ba330.php (Accessed 22 May 2013).

ft³ Olympus.[82] If successful, the Olympus will have double the internal volume of the ISS. Given the changing nature of the American space program, Bigelow Aerospace's efforts are important as they open the potential for creating new markets and destinations in low Earth orbit as an alternative to the ISS.

Connecting the Dots for Implementation

The Type 3 human spaceflight exploration strategy proposed within this research represents a solid balance across ends, ways, and means. However, simply designing a strategy is not enough to accomplish US national spacepower goals. The strategy describes the how and what of space exploration, but does not address why key groups should lend their support. To avoid the ill fate of previous

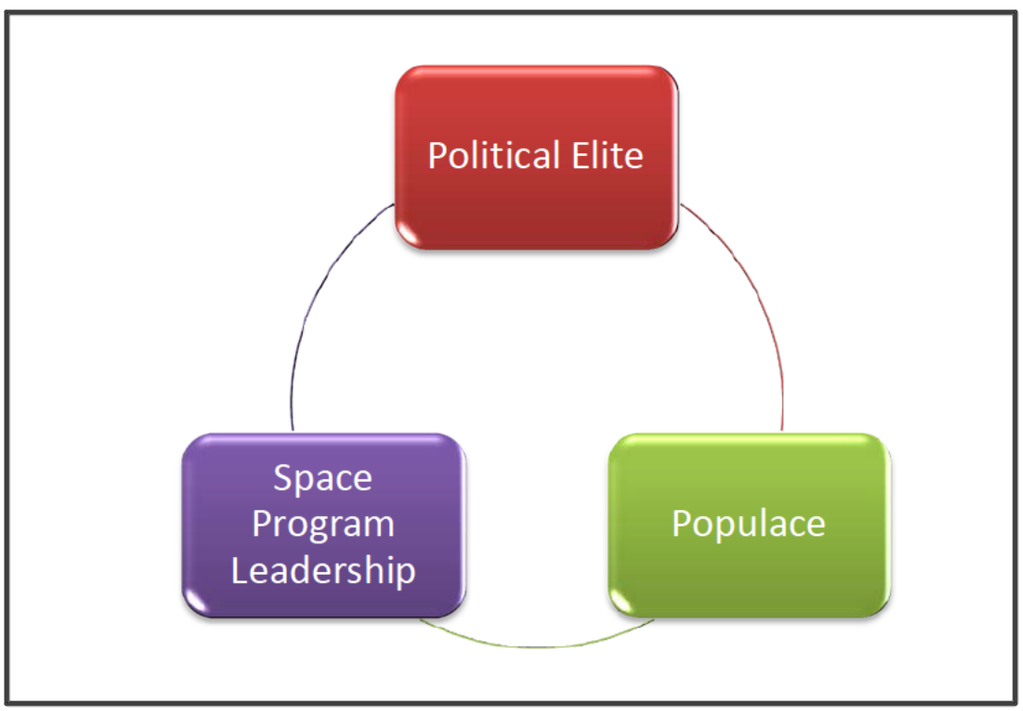

Figure 66: Space Program Support Triumvirate

[82] Adam Higginbotham, "Robert Bigelow Plans a Real Estate Empire in Space," *Bloomberg Businessweek*, 2 May 2013, http://www.businessweek.com/printer/articles/113942-robert-bigelow-plans-a-real-estate-empire-in-space (Accessed 20 May 2013).

national efforts, such as the SEI and VSE, this strategy must also focus on balancing the interests of three important groups; the populace, space program leadership, and America's political elite. Each group has an important role to play, features its own measure of cost/benefit, and approaches human spaceflight exploration according to unique preconceived notions. To enable success, spacepower strategists must understand the underlying levers of this triumvirate in order to secure broad support.

Within the US, harnessing the wonder and enthusiasm of the American populace has been a foundation to build legitimacy for space exploration efforts. The American populace still holds a tremendous fascination with the dream of space travel and adventure. At the dawn of the space age, Arthur C. Clarke poignantly captured society's burgeoning hope and passion for the emerging era of spaceflight in his book, *The Exploration of Space.* Clarke's narrative, published in 1951, was famous for its detailed technical blueprint for interplanetary travel and artful vision of humanity's coming divine-like evolution. Speculating how a historian 3000 years in the future would reflect back upon the space achievements of the twentieth century, Clarke wrote,

> Man realized at last that the Earth was only one of many worlds; the Sun only one among many stars. The coming of the rocket brought to an end a million years of isolation. With the landing of the first spaceship on Mars and Venus, the childhood of our race was over and history as we know it began…[83]

This special charm still thrives in the appeal of space adventure in popular culture. For example, the second highest-ranking film franchise in history, eclipsed only recently by the *Harry Potter* movies, is

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[83] Arthur C. Clarke, *The Exploration of Space* (New York: Harper & Brothers, 1959), 195.

the *Star Wars* series of films.[84] Since its debut in 1977, the space sci-fi world of George Lucas has generated over $4.2 billion in ticket sales with an additional $30 billion in merchandising.[85] In similar fashion, the *Star Trek* franchise of Gene Roddenberry continues an unprecedented near five-decade run complete with twelve motion pictures and six unique television series.[86] Within the video game industry, series such as *Halo*, *StarCraft*, and *Asteroids* rank in the top 25 titles of all time.[87] As further evidence, within two weeks of opening its application window in April 2013, over 78,000 people worldwide applied to join the Mars One project; an organization established to send private astronauts on a one-way trip to Mars.[88] In October 2012, a record setting 8 million internet users followed Felix Baumgartner's Red Bull Stratos jump live via YouTube.[89] For comparison, the next most popular YouTube live event was the 2012 London Olympics at 500,000 viewers.[90] Hence, the infatuation of the populace with human spaceflight exploration remains strong. Unfortunately, this source of support remains relatively untapped and is increasingly at odds with the reality of government-directed space exploration.

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[84] "The Force: Star Wars Franchise Worth Over $30 Billion," *24/7 Wall Street*, 10 February 2012, http://247wallst.com/2012/02/10/the-force-star-wars-franchise-worth-over-30-billion-and-growing/ (Accessed 24 May 2013).
[85] "The Force: Star Wars Franchise Worth Over $30 Billion," *24/7 Wall Street,* (Accessed 24 May 2013).
[86] Matthew Yglesias, "I Boldly Went Where Every Star Trek Movie and TV Show has Gone Before," *Slate*, 15 May 2013, http://www.slate.com/articles/arts/the_completist/2013/05/star_trek_movies_and_tv_series_which_are_the_best_why.html (Accessed 25 May 2013).
[87] "G4 TV's Top 100 Games," *G4*, http://www.g4tv.com/top-100/ (Accessed 25 May 2013).
[88] Mike Wall, "78,000 apply for private Mars colony project," *Foxnews*, 11 May 2013, http://www.foxnews.com/science/2013/05/11/78000-apply-for-private-mars-colony-project/ (Accessed 26 May 2013).
[89] Catherine Smith, "Red Bull Stratos YouTube Live Stream Attracts Record Number of Viewers," *The Huffington Post*, 14 October 2012, http://www.huffingtonpost.com/2012/10/14/red-bull-stratos-youtube_n_1965375.html (Accessed 24 May 2013).
[90] Catherine Smith, "Red Bull Stratos YouTube," (Accessed 24 May 2013).

Space historian William E. Burrows best summarized this growing disillusionment. In his 2006 book, entitled *The Survival Imperative*, Burrows lamented, "The manned space program is in shambles. Indeed, if a program, in this sense, is defined as a comprehensive undertaking with an articulated, coherent goal, there is no manned program."[91] The general populace, unable to reconcile prophecies of futuristic galaxy-roaming starships with today's space exploration stagnation, has become more and more disconnected from America's space program. Furthermore, the exclusivity of human spaceflight has also actively estranged some portions of the American populace to government spaceflight. As observed by space historians Roger Lanius and Howard McCurdy,

> Despite the promise that the shuttle, like a jet aircraft, would make spaceflight accessible to the common man, space travel remains the province of a favored few, perpetuating inequalities rather than leveling differences. Space exploration has remained largely a male frontier, with little room for women and minorities.[92]

For the 80 million people of the critically important Millennial generation, those born between 1980 and 2000, NASA is more associated with the Challenger disaster, Shuttle-*Mir* program difficulties, astronaut sex scandal, and Columbia tragedy rather than the triumph of the Apollo moon landings. This demographic, labeled in a May 2013 *Time Magazine* article as "The Me Me Me Generation," is accustomed to direct participation in major world events via social media, as opposed to vicarious experience as side-line observers.[93] As a result, Millennials

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[91] William E. Burrows, *The Survival Imperative* (New York: Tom Doherty Associates, 2006), 236.
[92] Roger D. Lanius and Howard E. McCurdy, *Spaceflight and the Myth of Presidential Leadership* (Chicago: University of Illinois Press, 1997), 239.
[93] Joel Stein, "Millennials: The Me Me Me Generation," *Time Magazine*, 20 May 2013, http://www.time.com/time/magazine/article/0,9171,2143001,00.html (Accessed 25 May 2013).

are culturally unable to associate with the human spaceflight heroes and achievements of yesteryear, yet are also unable to connect with modern human spaceflight due to a lack of transcendent events with which they can have direct involvement.

This phenomenon was detailed in a 2007 NASA perceptions study in which the majority of respondents viewed the space agency as becoming increasingly irrelevant because; 1.) The populace did not understand the linkage between NASA activities and daily life and 2.) NASA did not engage in activities that involve members of the public directly, especially the younger generation.[94] The survey concluded,

> [NASA's] benefits to the nation are not perceived as directly or clearly as those associated with other national programs. Although it is difficult for many space advocates to believe, this absence of specific knowledge about NASA's activities is quite widespread.[95]

Therefore, the American populace remains deeply enthralled by the prospect of human spaceflight exploration. Simultaneously, they are also disenchanted, apathetic, and estranged from America's current space program. Fortunately, this tension represents a source of great latent potential. If given a transcendent and relevant goal, the opportunity for direct societal participation, and the prospect for creating a new generation of exploration heroes, the populace will rally space program support and generate widespread legitimacy. As discussed earlier in this chapter, the spread of commercial human spaceflight is one vitally important emerging tool for building a space-minded society willing to sponsor audacious exploration programs. In addition, space program leadership, the second group in this

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[94] Mary Lynne Dittmar, "Sustaining exploration: communications, relevance, and value," *The Space Review*, 12 November 2007, http://www.thespacereview.com/article/1000/1 (Accessed 25 May 2013).
[95] Dittmar, "Sustaining exploration," (Accessed 25 May 2013).

triumvirate, can advance several more fronts to build support for human spaceflight exploration's role in American spacepower.

Space program leadership must revamp NASA's strategic messaging campaign. The key tenets of this campaign must focus on two areas; 1.) Combatting public misperceptions as to space program cost and 2.) Using NASA's extensive media outreach capabilities to deliver a cohesive and compelling message explaining the need for human exploration in both pragmatic and idealistic terms.

With respect to cost, the findings from the 2007 NASA perceptions study revealed the American public believed NASA consumed 25% of the federal budget.[96] This amount was second only to budget perceptions concerning the DOD; a federal agency perceived to spend 33% of the federal budget.[97] While respondents moderately overestimated the DOD's budget allocation, 21% (actual) versus 33% (perceived), the perception surrounding NASA's budget was amiss by several orders of magnitude.

As evidence, the US government budgeted approximately $3.6 trillion in spending for FY11.[98] The federal government allocated over 60% of this budget to mandatory spending on items such as serving net interest payments on the federal debt and funding Medicare, Medicaid, and Social Security entitlements.[99] Of the remaining $1.3 trillion in discretionary spending, military defense received $700 billion while

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[96] Dittmar, "Sustaining exploration," (Accessed 25 May 2013).
[97] Dittmar, "Sustaining exploration," (Accessed 25 May 2013).
[98] "CBO's Budget Infographic," *Congressional Budget Office*, 12 December 2011, http://www.cbo.gov/publication/42635 (Accessed 24 May 2013).
[99] "CBO's Budget Infographic," Congressional Budget Office, (Accessed 24 May 2013).

$646 billion remained for all other non-defense spending.[100] Of the non-defense discretionary funding, NASA received only $18.4 billion.[101]

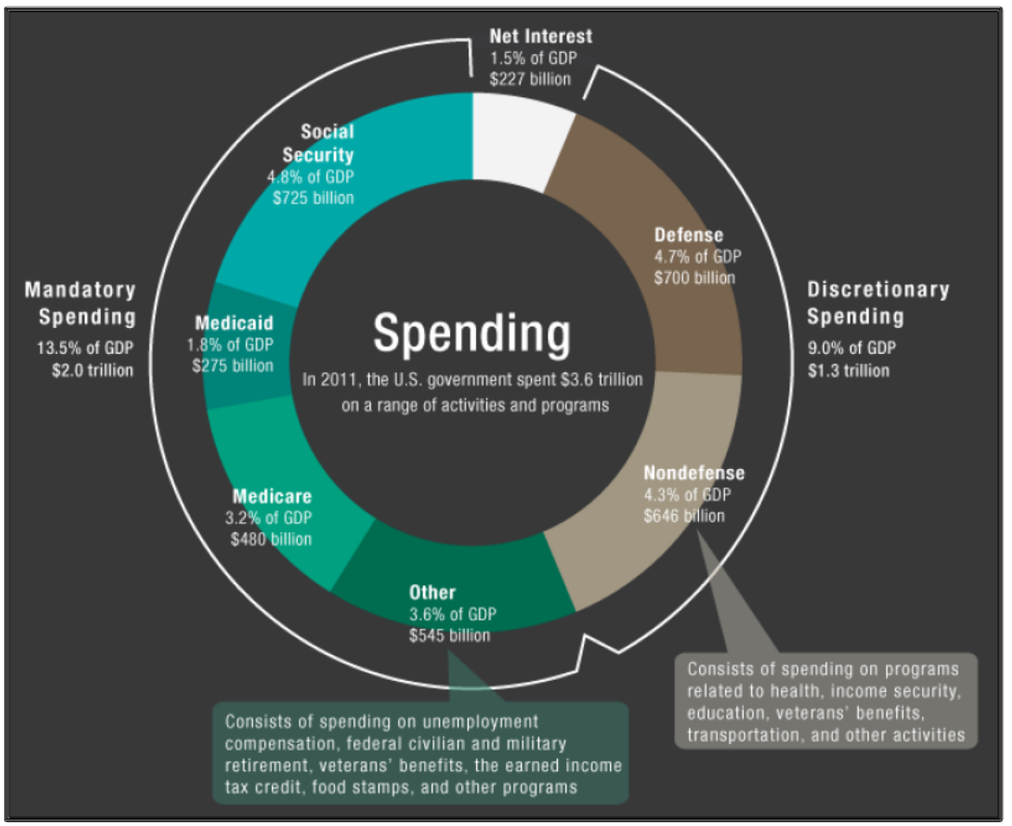

Figure 67: FY11 US Federal Budget

Source: Congressional Budget Office, http://www.cbo.gov/publication/42635

Internal to NASA, $3.8 billion of its FY11 budget funded the development of exploration systems, such as the SLS, MPCV, and CCDev, while $5.5 billion funded ongoing space operations such as the International Space Station and the close out of the Space Shuttle

[100] "CBO's Budget Infographic," Congressional Budget Office, (Accessed 24 May 2013).
[101] Doug Messier, "Six Months Late, Congress Finalizes NASA Budget for FY 2011," *Parabolic Arc*, 15 April 2011, http://www.parabolicarc.com/2011/04/15/months-late-congress-finalizes-nasa-budget-fy-2011/ (Accessed 25 May 2013).

program.[102] Hence, as compared to the discretionary portion of the US federal budget, human spaceflight exploration amounted to 0.5% of the budget, or half of a penny for every tax dollar. When compared to the total US federal budget, human spaceflight exploration equated to 0.1%, or one tenth of one penny per federal tax dollar.

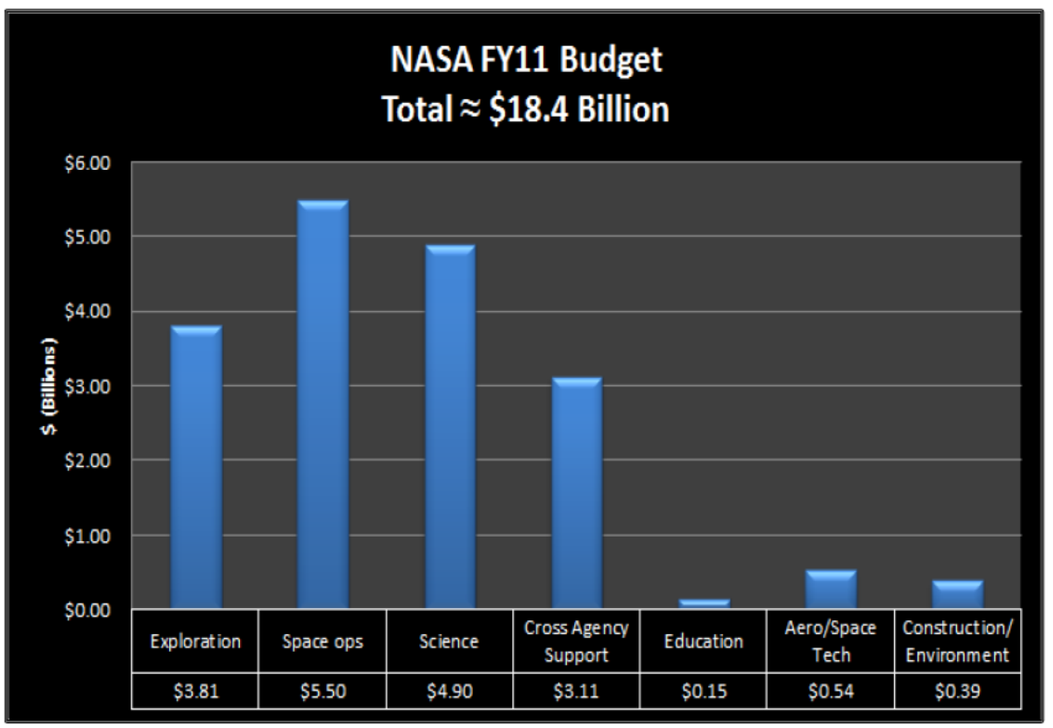

Figure 68: FY11 NASA Budget Allocation

Source: NASA, http://www.parabolicarc.com/2011/04/15/months-late-congress-finalizes-nasa-budget-fy-2011/

By either measure, the general populace grossly misperceives the financial expense of space exploration. While the same lack of public understanding exists concerning the cost of most federal programs, NASA's showcase role makes this lack of knowledge especially troubling for its future. So long as this distortion exists within public perception, the populace will always view NASA's benefits to society as outsized

[102] Doug Messier, "Six Months Late," (Accessed 25 May 2013).

when compared to its cost. Therefore, messaging budgetary truth is vitally important for securing public support. However, this effort would only addresses one aspect of the space program's strategic messaging problem. The second aspect must focus upon delivering a powerful message concerning the agency's identity and purpose.

Figure 69: Astronaut Chris Hadfield aboard the ISS

Source: http://mashable.com/2013/05/19/chris-hadfield-on-earth/

NASA already has at its disposal one of the finest outreach message delivery systems in the US government. NASA's brand recognition is rivaled globally only by Coca-Cola and the space agency has won numerous awards for its television channels and internet presence.[103] For example, astronaut Chris Hadfield leveraged NASA's extensive outreach capabilities to deliver inspirational messages and personable videography from the ISS to nearly 1 million Twitter users.[104]

Unfortunately, this impressive outreach system lacks a cohesive message designed to coalesce public support towards NASA's ultimate goals regarding human exploration. To date, the public remains largely unaware of NASA's overall purpose or the need for human spaceflight. The relevance of research activities aboard the ISS are opaque and the destinations and future capability developments for the MPCV/SLS remain vague. Furthermore, NASA has not embraced the recently proposed asteroid mission internal to its organization; many NASA

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[103] "NASA's Twitter Account wins back-to-back Shorty Awards," NASA, Release 13-0103, http://www.nasa.gov/home/hqnews/2013/apr/HQ_13-103_NASA_Gets_Shorty.html (Accessed 25 May 2013).

[104] Glen Tickle, "Chris Hadfield is Still Great on Earth: Some of His Best Earthbound Tweets," *Mashable*, 19 May 2013, http://mashable.com/2013/05/19/chris-hadfield-on-earth/ (Accessed 26 May 2013).

employees view the mission more as a distraction than as an enabler for conducting interplanetary exploration.[105]

Hence, space program leadership, in collaboration with the executive branch of the US government, must clearly and consistently message its overarching goals, architecture for the MPCV/SLS, and strategic imperative for creating a multi-planet species. The rationale for the ISS and proposed asteroid mission must incorporate into this larger narrative in order to gain wider acceptance. This strategic message must emphasize the transcendent, rather than the routine, highlight the immediate pragmatic benefits of exploration, and must be of enduring significance so as not to generate momentary enthusiasm at the expense of long-term commitment. In addition to this study's argument for using human spaceflight to garner national honor, William E. Burrow's book, *The Survival Imperative*, argues for NASA's primary mission to focus on species survival and planetary defense against global catastrophe, i.e. asteroid impact, pandemics, nuclear war, etc. According to Burrows, the embrace of a strategic mission of this magnitude would rank as the perfect mix of pragmatism and idealism.

> Using space to protect civilization, providing an environment in which it is able to collectively thrive and grow to its limitless potential, will transform humankind from its traditional role as the hapless victim of fate to one better able to control its destiny and fulfill its inherent, and perhaps unique, potential for greatness.[106]

As detailed by this research, efforts along Burrow's suggested course of action may not cross the imminent threat threshold necessary to elevate NASA's Type 3 exploration to a Type 2 or 1 effort. However, solidifying the space program's strategic message and goals, either for national honor or for planetary defense, would at least rally NASA

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[105] National Research Council, *NASA's Strategic Direction,* 33.
[106] Burrows, *The Survival Imperative*, 250.

internally towards its overarching purpose and engage the natural space exploration fascination of the general populace. Efforts between the populace and space program leadership may then be able to influence the final group, America's political elite.

Within a democracy, widespread political support is a pre-requisite for implementing national initiatives. Concerning space exploration, however, this fact is lost upon history. President Kennedy's famous moon landing speech before Congress on 25 May 1961 set the false paradigm that space initiatives only require a Presidential decree. In reality, the unique geo-strategic imperative of the Cold War, abundant economic resources, and availability of engineering talent made the quick political adoption of the President's lunar exploration program an exceptionally unique occurrence in history. As observed by space historians Roger Lanius and Howard McCurdy,

> Space policy is not above politics. Presidential mandates do not guarantee program success. Chief executives cannot protect the civilian space agency from the forces that batter other discretionary spending programs. Space policy exceptionalism, as attractive as that notion continues to be, is not an appropriate view of reality.[107]

This fact was evident by President Reagan's failed 1984 Space Station Freedom initiative, President George H.W. Bush's defunct 1989 SEI, and the decay of President George W. Bush's 2004 VSE. The schism between the executive and legislative branch about space policy has become especially prevalent in recent years. Strategists must understand and addresses this growing divide in order to secure the necessary political support for future strategy success.

Specifically, the sudden cancellation of the Constellation program by President Barack Obama created major ripples throughout the

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[107] Lanius and McCurdy, *Spaceflight and the Myth of Presidential Leadership*, 222.

political sphere. Republicans viewed the abrupt cancellation as a political move from a hostile Democratic administration. Democrats cast the move as a chance to revitalize the space industry with fresh initiatives. As a counter, Republican Senators Richard Shelby of Alabama, Bob Bennett of Utah, and Kay Bailey Hutchinson of Texas sponsored a 2010 bill preventing further stop-work on the Constellation program in the aftermath of its cancellation.[108] While ostensibly designed to prevent job losses in their heavily NASA favored states, the bill's true purpose was to spite the President by stalling the start of his administration's new space initiatives. The bill also placed NASA in the untenable position of spending limited fiscal year funds on a dead program.

In the subsequent debate over the future of the space program, two factions have solidified along bitter partisan lines. Republicans favor funding old-space development, namely SLS and MPCV, due to the large presence of NASA and NASA contracted facilities within their congressional districts and well established relationships with powerful aerospace lobbies. Opposing them are Democrats who favor solidarity with the President's new-space initiatives, such as SpaceX and Orbital. To date, Republican leadership has been successful in blocking the President's full requested funding for CCDev, viewing such investments in new-space as a threat to the development of old-space in a sequestered budget environment. However, this argument is a false debate; structured more for the appearance of job protection and political obstructionism than for greater exploration ends. Political squabbling of this nature has done little to accelerate the development SLS/MPCV, delayed arrival of CCDev to the space station until at least 2017, and forced NASA to pay the Russian Space Agency an additional

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[108] Gautham Nagesh, "Senators go to bat for NASA's Constellation program," *Hillicon Valley*, 14 May 2013, http://thehill.com/blogs/hillicon-valley/technology/97925-senators-go-to-bat-for-nasas-constellation-program (Accessed 20 May 2013).

$424 million for contracted transportation services to the ISS.[109] This approach will doom America's human spaceflight program to failure.

Instead, Republican and Democratic politicians must realize that there is no old-space or new-space, only one space program whose collapse would have immediate negative effects upon their own political futures. Under this new paradigm, efforts to support commercial and government space efforts are synergistic. For example, Director Patrick Scheuermann, current NASA administration for the Marshall Spaceflight Center, acknowledged the economic benefits for Huntsville Alabama if local aerospace firms leveraged their expertise to support both government and commercial human spaceflight efforts. As stated by Director Scheuermann,

> As new partnerships are formed, the fact is reinforced that if you're serious about getting into the space business, Huntsville – which has the highest number of engineers per capita – and the Marshall Space Flight Center are where you should consider partnering.[110]

Kennedy Space Center Director Bob Cabana echoed this sentiment. Concerning modernizing the launch complex for COTS/CCDev companies and pure commercial vendors, Director Cabana acknowledged, "The goal here is to bring commercial companies to the Cape in the best way possible and I will do whatever is required to

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[109] Ledyard King, "Political wrangling pulls NASA in different directions," USA Today, 10 May 2013, http://www.usatoday.com/story/news/politics/2013/05/10/congress-and-administration-at-odds-on-nasa-mission/2151559/ (Accessed 26 May 2013).
[110] Chris Bergin, "MSFC Director: Commercial Space should be serious about Huntsville," 29 January 2013, NASA Spaceflight, http://www.nasaspaceflight.com/2013/01/msfc-director-commercial-space-serious-huntsville/ (Accessed 25 May 2013).

get those companies utilizing assets, what we have here, to make commercial operations a reality at the Cape."[111]

Finally, politicians must realize that while constituents require jobs, they also thrive on purpose for their work beyond simply generating a paycheck. Creating national space programs, only to have them canceled before achieving fruition, robs constituents of the sense their work contributes to something transcendent. It also deprives politicians of the pride and political boost derived when their district or state meaningfully contributes to an achievement of significant worth to all of humankind. Given the already canceled Constellation program, further human spaceflight exploration instability only increases the risk of breeding additional voter frustration in key Presidential election swing states with important space industries, such as Ohio, Florida, and Colorado. This also runs the risk of funneling more federal funds to Russia and crippling the birth of a new industry in America; an unseemly political scenario no Senator or Representative should want in a struggling US economy. Because of the emerging close intertwining of government and commercial spaceflight, neither political party is immune to the debilitating effects of a failed space program. Therefore, for sake of their own political prospects, politicians must cease political wrangling and compromise with respect to supporting human spaceflight initiatives according to this emerging government-commercial hybrid strategy.

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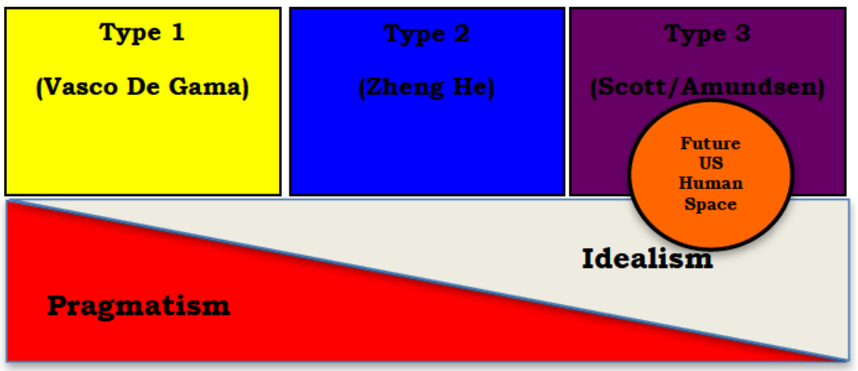
[111] "Cabana: NASA may free up land for commercial spaceport," Florida Today, 15 May 2013, http://www.floridatoday.com/article/20130515/NEWS01/305150030/Cabana-NASA-may-free-up-land-commercial-spaceport (Accessed 25 May 2013).

Conclusions



Professor James Van Allen, discoverer of the Van Allen radiation belt, was always a great opponent of human spaceflight. In his estimation, human spaceflight was far too expensive for the benefits achieved. He argued that governments should instead spend resources on robotic exploration and surveillance spacecraft. He even went so far as to charge that human spaceflight was becoming obsolete. In a strange sense, Professor Van Allen was both correct and incorrect.

As stated aptly in the opening lines of the 2009 Augustine Commission presidential report on human spaceflight, "The U.S. human spaceflight program appears to be on an unsustainable trajectory. It is perpetuating the perilous practice of pursuing goals that do not match allocated resources."[112] In this light, human spaceflight, under the old government directed technocratic paradigm, was in danger of becoming a fiscal morass. The current US economic and political environment threatened to prove Professor Van Allen correct.

However, crisis offers a moment fraught with both danger and an excellent opportunity for positive change. In a paradoxical twist to Professor Van Allen's beliefs, uninhabited spaceflight benefits from a

[112] Review of US Human Spaceflight Plans Committee, *Seeking a Human Spaceflight Program,* 9.

robust human spaceflight program. Frank Culbertson, retired US Navy Captain, former astronaut, and current vice president for Orbital Science's Advanced Program Group, best summarized the reason for this when he stated, "There will always be something inspirational about the human presence in space. People identify with people who fly in space because that connection puts the rest of the human population into space."[113] Therefore, human spaceflight is distinctive in that it generates a powerful undercurrent of inspiration useful for bolstering a nation's overall efforts in space, whether human or uninhabited. Spin-off technologies developed to support human spaceflight, such as efficient, reliable, and low-cost space lift, can provide significant enhancement to US national security capabilities. In addition, new human spaceflight innovations may emerge that challenge the current military spaceflight paradigm and open fresh avenues for human spaceflight in national security applications. Therefore, the value of human spaceflight to a state is therefore of much greater significance than indicated by Professor Van Allen.

In addition, the emerging hybrid partnership between government and commercial entities prove that human spaceflight is far from obsolete. Instead, this new paradigm represents a viable way for the achievement of space strategy ends using pragmatic means. Innovations within an emerging US commercial human spaceflight industry offer spacepower strategists advanced capabilities at significant cost savings. National leadership's support of these nascent technologies is crucial for the viability of American state power. Spacepower strategists must appeal to the interests and capabilities of the populace, space program leadership, and political elite in order to insure the implementation this new hybrid human spaceflight exploration strategy. Amidst the current environment of austere

[113] Frank Culbertson (Orbital Sciences), interview by the author, 21 March 2011.

economic and political state resources, this is the only spacepower strategy capable of advancing US space leadership into the future.

Chapter 8

CONCLUSIONS

From the past…the future.

> *The bottom line is, nobody is more committed to manned spaceflight, to human exploration of space than I am, but we've got to do it in a smart way and we can't just keep on doing the same old things we've been doing and thinking that somehow that's going to get us where we want to go.*
>
> President Barack Obama, 2011

The exploration of space continues as this era's equivalent to the ancient world's Pillars of Hercules. Much as the perils of sea monsters or the thrills of treasure awaited those who ventured past this portal to the Atlantic, the allure of space as a destination for human exploration continues its siren call to the states of the world. The pragmatic wisdom of Thucydides, and the idealistic notions of John Locke and Immanuel Kant ring as true today in Earth orbit as their concepts did over the unexplored continents and oceans of modern history. The formidable dichotomy between pragmatism and idealism continues to color the nature of a state's exploration.

The campaigns of modern history, epitomized by Admiral Zheng He, Vasco De Gama, and the South Pole race between Amundsen and Scott, represent the three significant themes within state exploration. Studying these three historic campaigns and several sub-vignettes reveals the necessary and sufficient conditions of exploration. These factors form the independent variables of this study. Specifically, the two necessary conditions for state exploration define as the existence of a frontier and the resources/technical means with which to access that frontier. However, the presence of these two conditions is not enough to

ensure exploration will begin. The historical survey conducted for this research reveals that the sufficient condition is the existence of a competitive risk to an element of national security; expressed in this research as the Thucydidean concepts of fear, honor, and interest. Within a state's strategic culture and geo-strategic context of the era, competitive risk can be deemed low (peripheral) to state concerns, medium (important) to state grand strategic objectives, or high (existential) to the state's survival. Studying the explorations of modern history also illuminates how the forces of pragmatism and idealism, combined with the necessary and sufficient conditions, produce simple, repeatable, and recognizable patterns that determine the nature of an exploration campaign. This nature thus becomes the dependent variable of this research. From this standpoint, national security pragmatism is the initiating spark of exploration while idealist principles create the flame to build an enduring legacy and support long-term legitimacy. Both forces require each other and each has an important role to play. State exploration campaigns are therefore a synthesis of these two dichotic standpoints. This knowledge helps to answer the well-worn question, "Why do states explore?" Understanding exploration from this standpoint provides great discernment for the strategist in understanding the manner in which state explorations initiate, sustain, and conclude. Hence, the resulting Exploration Model shown below is useful in understanding the strategic role and future of human spaceflight.

Exploration Model

Independent Variables	Necessary Conditions	Existence of Frontier, Technological/Resource Means to Access Frontier		
	Sufficient Condition	State Competition Risk Sparked by Fear, Interest, and/or Honor		
	Risk Perception of Competition	Medium (Important)	High (Existential)	Low (Peripheral)
Dependent Variable (Nature of the Exploration Campaign)		**Type 1 (Vasco De Gama)**	**Type 2 (Zheng He)**	**Type 3 (Scott/Amundsen)**
	Primary Theme	Primarily Pragmatism	Rough Parity Mix of Pragmatism & Idealism	Primarily Idealism
		Pragmatism ↘ **Idealism**		
	Character	-Most Common -Easiest to Initiate -Innovates Exploitation of New Domain -Resourced Adequately -Reasoned Tech Develop -Objective Aim & National Endstate -Incidental Transcendence	-Over Resourced -Balance of Venturing and Exploitation -Hyper Focused Tech Develop -Objective Aim & Subjective National Endstate	-Least Common -Difficult to Initiate -Focused on Venturing into New Domain -Modestly Resourced -Modest Tech Develop -Subjective Aim & National Endstate -Enduring Transcendence
	Terminate	-Urgent National Security Issue Resolved -Means of Execution Becomes Obsolete -Defeat	-Sudden Shift in Geo-Strategic Context/Leaders	-Resourcing Superseded by Urgent National Security Need -Spoils Claimed First by Competitor

Explorations feature primarily pragmatist thought, a rough equivalence of pragmatism and idealism, or focus upon idealistic views. The Exploration Model broadly designates these combinations as Type 1, 2, and 3 respectively. These type classifications delineate important attributes of an exploration campaign that have repeated throughout history regardless of era or state. The survey and analysis conducted for chapters 2 through 6 of this dissertation demonstrate this Exploration Model's relevance to state expeditions from yesteryear as well as the Space Age campaigns of today. Hence, a strategist can reasonably assume these patterns will continue into the future and can therefore use this model as a predictive tool for the future of human spaceflight in US grand strategy.

Throughout the previous 50 years of spaceflight, America has maintained overall global space leadership. However, recent challenges to the space prowess of the US have emerged due to a tremendously constrained economic and political environment, as well as increased competition from nations such as China. Looking towards the future, the Exploration Model indicates a Type 3 class of human spaceflight exploration is the best solution to secure America's future spacepower leadership. Based on the research conducted for this study, human spaceflight is especially adapted for this role in US grand strategy. From an idealistic standpoint, campaigns to destinations beyond cis-lunar space will serve as the ultimate transcendent goal to inspire humankind and garner significant American prestige. From a pragmatic standpoint, explorations of this nature help develop long–term technologies and an industrial base useful for addressing US national security. However, the catalyst to initiate this campaign is still wanting. Based on an analysis of American strategic culture, this lack of an immediate imperative spark is a significant challenge to overcome. The most likely source for this spark will be a future Chinese human spaceflight mission to the moon; a

direct competitive risk to America's honor as the sole nation on Earth to accomplish this feat. Another potential spark is the realization of an impending threat to planetary survival; however, achieving sufficient advanced warning of such a threat is difficult given the limitations of early detection systems and a general lack of perceived urgency. Absent this catalyst, America's human spaceflight program runs the real risk of languishing in obscurity. This fate is especially likely without the re-establishment of clear strategic ends, a major reshuffle of NASA's organization to streamline cost and enhance focus, steadfast leadership, innovative solutions, and consistent political/public support. Given the limited resources of today's realities, changes of this magnitude are an absolute must if America's human spaceflight program expects to survive and grow. Fortunately, several emerging opportunities offer the chance to leverage the unique strengths of the United States for advantage in the face of rising competition and dwindling resources.

Shifting the ways of American space strategy from a purely technocratic to a hybrid strategy between technocracy and *laissez-faire* style development offers a viable solution to achieve spacepower ends. This approach, with respect to human spaceflight, leverages the unique strengths of both the government and commercial industries. America, amongst all nations on Earth, is the only state structured to take full advantage of this unfolding partnership. Recent advances in technology spanning the gamut from suborbital to deep spaceflight provide a unique wellspring of resources or means to support the strength of America's overall spacepower. In much the same way as aircraft flight during the Golden Age of aviation, the US government can benefit greatly by adapting the most promising of these technologies via a fast adopter approach. Amidst the current environment of austere economic and political state resources, this human spaceflight partnership between government and commercial entities provides harmony across

spacepower ends, ways, and means. This strategy offers the best chance of achieving US space leadership for the future.

Implementing this strategy will not be easy, however few changes of this scale birth without struggle. The challenges are many. For example, the populace possesses the passion for space exploration, but lacks connection with America's space program. Space program leadership holds one of the most capable outreach programs in the US government, but lacks a strategic messaging campaign to correct cost misperceptions and clarify NASA's identity and goals. Finally, America's political elite remains mired in partisan wrangling and unable to perceive the immediate benefits of supporting both government and commercial spaceflight efforts. None of these obstacles are insurmountable; persistence can overcome these challenges in addressing the unique needs of each group. In this light, the insight of Niccolo Machiavelli, famed sixteenth century advisor to the Florentine leadership of Italy, offers a future space strategist wise advice.

> It must be considered that there is nothing more difficult to carry out, nor more doubtful of success, nor more dangerous to handle, than to initiate a new order of things. For the reformer has enemies in all those who profit by the old order, and only lukewarm defenders in all those who would profit by the new order, this lukewarmness arising partly from fear of their adversaries, who have the laws in their favor; and partly from the incredulity of humankind, who do not truly believe in anything new until they have had the actual experience of it.[662]

Geryon waits at the metaphorical Pillars of Hercules. The only question remaining is whether the US will marshal efforts to accept Eurystheus' labor of redemption, or whether another state will claim that challenge first.

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[662] Niccolo Machiavelli, *The Prince* (New York: New American Library, 1952), Book 6.

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